THE AEROPLANE

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Aeronautical Engineering
Edited by - - THURSTAN JAMES

Founder and First Editor
(1911-1939), C. G. GREY

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THE SPACE AGE COMETH

ON April 14, as we announce on the next page, a "Space Age" conference is to be held in the Festival Hall under the ægis of the Air League of the British Empire of which the Duke of Edinburgh is patron. Marshal of the Royal Air Force Sir Dermot Boyle is to take the chair. The object of the organizers is to give an introduction to the scientists, engineers and technologists of the future of the problems and possibilities of travel through outer space. Congratulations to the Air League! Once again it has taken a lead in air affairs that might have been expected from more official quarters.

We are so used to secrecy over British experiments and developments with guided weapons that people may be excused for overlooking the remarkable omission of pronouncements, by those best qualified by position to speak, on the subject of how this country proposes to tackle the problems of space travel. Nothing has been said about the technical programme which will lead to British-designed-and-built satellites and thence to British-built spacecraft. Or would readers prefer us to talk of astronaves? There is something too reminiscent of science fiction in the words "spaceship" or "spacecraft."

If some of those people who have not yet digested the lesson of the circling man-made satellites that put a girdle round the earth every two hours think we are straying unjustifiably far from the paths of aeronautics we would remind them of the significant words written by the Chief of the Air Staff in THE AEROPLANE for March 28. In a specially written article dealing with the future of the Royal Air Force, Marshal of the Royal Air Force Sir Dermot Boyle said:—

> ". . . but I do not myself believe that the unmanned missile is the end of the story. One of these days I think we shall see the manned vehicle—at present over the horizon but sooner or later bound to appear—which can reconcile the concepts of the supersonic bomber and the manned satellite."

The question arises: what is this country doing about such things? It is fine to have a conference to enlist and recruit the enthusiasm of the rising generation. But what will the future be for that generation, if the generation now at the helm and the generation manning the ship of state are content to let the United States and Russia do all the pioneering into the space beyond our atmosphere?

It seems to us that, in a world which now can launch as many satellites as it wishes, a nation such as the United Kingdom cannot just carry on in its accustomed, somewhat lethargic, way. Its people have got to be put abreast of the times; they must be made to realize what goes on; they will then exert pressure on those who control their affairs to show some enterprise in dealing with matters of astronautics.

A week or two ago when the United States successfully launched their third satellite (the date was March 26) the President of that great country made public a forecast by scientists that it may cost some £700 million to put a man on the moon and return him safely to earth. This estimate was made in a study of 4,000 words entitled "Introduction to Outer Space" prepared by a committee of scientists. This work, far from being secret, is to be generally released.

We have not heard of any similar committee preparing similar studies for our Premier. All the interest here at the moment seems to be focused on nuclear explosives, and yet how can the whole range of responsibility in this matter be considered in all its implications until we have been told how long it will be before British manned vehicles encircle the globe and return to earth at will?

In such circumstances it could well be that the young people attending the Space Conference of the Air League may play a much more immediate part in their country's affairs than the sponsors of the Conference envisaged. It could happen that the speakers will so fire the enthusiasm of their youthful audience that some two thousand proselytes will go home and to their places of study after the Conference, determined to get satisfactory answers from their seniors regarding the part that Britain is to play in the space age.

We are reluctant to say anything which people could describe as pouring cold water on such enthusiasm; nevertheless, we are conscious of the depressingly slow growth of interest in the civil supersonic transport which must be brought into being. And if progress is so slow in this field, how slow must we expect it to be when the problem is to plan manned spacecraft. Yet, somehow, that is what we must be doing, and doing now.

Of course, it is difficult to get British aeronautical engineers to concentrate on such matters at a time when orders for conventional aircraft are being curtailed. But this state of affairs is a challenge and if no official body or department of state will pick up the gauntlet, the Air League has a responsibility in this matter. We know the way to the stars is arduous but that is not a sufficient reason for being content to have no plan for getting British spacecraft above our atmosphere.

MATTERS OF MOMENT

A State Occasion

THE ceremonial and dignified brilliance of the traditional scene of a great Service occasion is rarely seen or known to any but the actual participants. The growing influence of the television services, however, and their accepted entry into the more intimate spheres of life on our behalf, do not allow even the dining-room of a famous Service Mess to be immune from intrusion nowadays when circumstances warrant. Perhaps that is right and proper when there is great celebration in which many of us feel we want to join—even, perhaps, feel entitled to join.

Such an occasion was the evening of Tuesday, April 1, this year, when the Royal Air Force, celebrating its fortieth year of existence, was honoured by the presence at dinner of the Queen and Prince Philip. With them also at the Headquarters of Fighter Command at Bentley Priory, Stanmore, were the Queen Mother, Princess Margaret, the Duke and Duchess of Gloucester, the Princess Royal and the Duchess of Kent.

The assembled gathering comprised a unique array of imposing seniority. Indeed, it must have been one of the few meetings, we shall ever see, of the great figures of the early R.A.F. with the officers holding the current reins and in the company of the leaders of the future.

In this respect one was led to reflect on the fact that Marshal of the Royal Air Force Sir Dermot Boyle, our present distinguished Chief of Air Staff—sitting on the Queen's left hand—graduated from Cranwell only a month or so before Sir John Salmond—sitting next to the Queen Mother—was appointed A.O.C.-in-C. Air Defence of Great Britain (now Fighter Command) and at that time soon to step into the job of C.A.S. in succession to Lord Trenchard. Here was history in a small space.

At the Queen's table, there were eight Marshals of the R.A.F. including many of the famous leaders of World War II, Lord Dowding, Lord Tedder, Lord Douglas of Kirtleside, Lord Newall and Sir Arthur Harris. In the groups assembled before dinner, and later at the tables, the television cameras picked out many of the men who have in peace and war brought fame and distinction to the pages of Air Force history. They, in fact, represented the years of the R.A.F., even from Laffan's Plain to the rocket ranges.

The Right Hon. George Ward, M.P., Secretary of State for Air, in welcoming Her Majesty, spoke at some length on the history of the Royal Air Force and said that in attaining full maturity it had established for itself a great place in our history. He reminded the company of the entry of King George VI into the ranks of R.A.F. pilots as the Duke of York in 1919 and told how his late Majesty had installed the control column of the Avro 504 in which he had flown solo, with the swords, lances and other military impedimenta at the museum in Windsor Castle.

The Queen proposed the toast of the Royal Air Force and began with a recollection of the fact that the R.A.F. was created by her grandfather on a spring day in 1918 when World War I was at a bitterly critical stage.

"The vision and determination of a few great men like Field-Marshal Smuts to found the new Service," Her Majesty continued, ". . . gave the free world a fighting chance a generation later.

"Under the inspiring leadership of Lord Trenchard it took increasing responsibilities all over the world. It pioneered a new technique of maintaining order on the wild fringes . . . and busied itself with all kinds of humanitarian activities—largely unknown to people at home. . . .

"Then in 1940 was fought the Battle of Britain which rightly takes its place with Trafalgar and Waterloo. . . ."

Her Majesty, concluding a graceful speech, spoke of the

TWENTY-FIRST BIRTHDAY.—Nearly 150,000 people (bottom left) gathered at R.N.Z.A.F. Station Chakea on March 29 to celebrate the coming of age of the Service of which Air Chief Marshal the Hon. Sir Ralph Cochrane was the first C.A.S. (with the rank of Group Captain). He is sitting (top left) between Vice-Admiral Sir John Collins, High Commissioner for Australia, and Mrs. P. G. Connolly, wife of the Minister of Defence. Top right, 23 members of the N.Z. Special Air Service Squadron jumping from an R.A.F. Hastings; in the foreground is an R.A.F. Valiant captained by New Zealand's only surviving Air Force winner of the Victoria Cross, Wg. Cdr. L. H. Trent, who also holds the D.F.C.

RACE MEETING.—But not for aeroplanes. The newly licensed airfield at Goodwood was well used on Easter Monday when the motor-racing season there opened.

Photograph copyright "The Aeroplane"

prospect of the R.A.F.'s fiftieth birthday when she was certain that "those who are left of that cheerful band of officers and airmen who remember the Service from its earliest beginnings will look with admiration upon a new generation of young men and women, flying the aircraft, controlling the missiles and working the magically complex technical equipment of a Royal Air Force that will still be young in spirit."

Britain Enters the Space Age

UNDER the above title a conference sponsored by the Air League of the British Empire will be held at the Royal Festival Hall, London, on April 14. Its purpose is to introduce to young people between the ages of 16 and 23 some of the problems and possibilities of space travel. The conference will be opened by H.R.H. The Duke of Edinburgh, Patron of the Air League, and Marshal of the R.A.F., Sir Dermot Boyle, K.C.V.O., K.B.E., A.F.C., Chief of the Air Staff, will be in the chair.

The subject will be primarily discussed by four speakers: Professor W. H. McCrea of the Royal Holloway College will talk about the nature and knowledge of outer space and the problems and challenge it presents; Mr. J. E. Pateman, senior technical executive (guided flight) of Elliott Bros. (London), Ltd., will describe control systems and navigation; Mr. A. C. Clarke, former president of the British Interplanetary Society, and a well-known lecturer on space travel, and Mr. D. G. King-Hely, of the R.A.E. They will then be joined by Professor Massey of the Royal Society, to form a Brains Trust, under the chairmanship of Sir Arnold Hall, director of the Hawker Siddeley Group, to answer questions put to them by members of the audience.

A number of models will be shown, including the Jupiter-C rocket, and the first American satellite "Explorer," which it put into orbit.

The conference is from 10.30 hrs. until 13.30 hrs. Time for getting tickets is running short. Applications should be made immediately to the Air League of the British Empire, Londonderry House, 19 Park Lane, London, W.1.

Ramjet Research at Bristol

IN his address of welcome to the guests at the opening ceremony for Bristol Aero-Engines' new high-altitude powerplant test chamber (described on pages 517 to 519), Sir Reginald Verdon Smith emphasized, on April 2, the need for continued engine development—on which, he said, the success of aviation depended. If we were persuaded by economic considerations to abandon such work, he went on, it would be at our peril, and particularly we must not allow ourselves to be left behind in ramjet technology.

It is principally for ramjet research that the new test facility has been built; and it will play an important part in the development of later versions of the Bloodhound guided missile. In this connection, Sir Reginald commented that the Royal Air Force had chosen Bloodhound with which to learn their guided-missile A.B.C., but thereafter they would go on to higher education with Bloodhound developments "from the Bristol kennels."

Air Marshal Sir Geoffrey Tuttle, K.B.E., C.B., D.F.C., Deputy Chief of the Air Staff, formally opened the test chamber. At a luncheon prior to the ceremony Sir Geoffrey had something to say about the importance of research and its effect on safety. And he made the point that the accident rate had persistently been going down ever since the R.A.F. was formed; this, he said,

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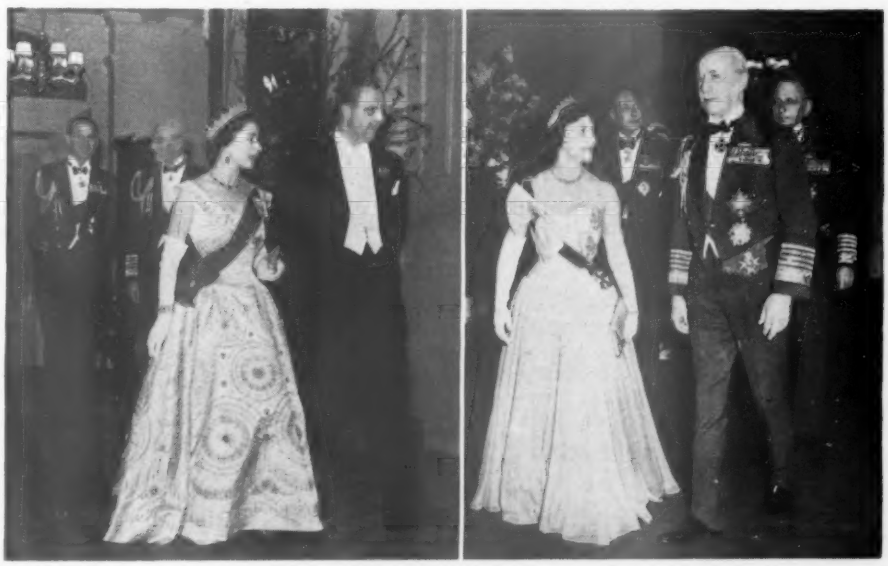
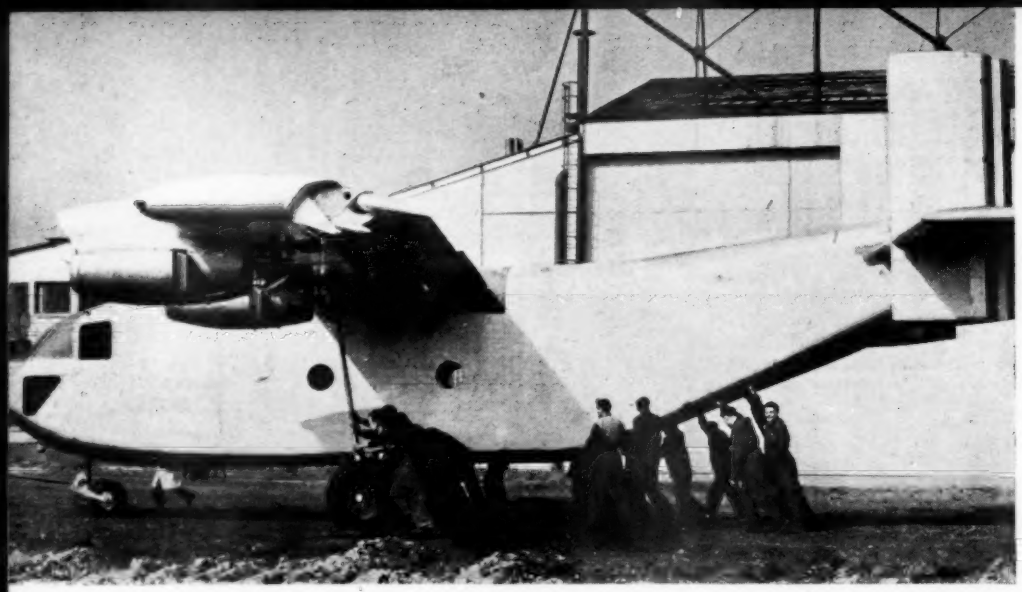


FORTIETH ANNIVERSARY.—H.M. the Queen with the Secretary of State for Air, the Rt. Hon. George Ward; behind her is Prince Philip with Marshal of the Royal Air Force, Sir Dermot Boyle, Chief of Air Staff. On the right, Princess Margaret is accompanied by Marshal of the Royal Air Force, Lord Newall; behind her is the Duke of Gloucester with Marshal of the Royal Air Force, Lord Tedder.



INTEGRAL ASPECT.—Nearing completion, the Breguet 940 Integral STOL aeroplane is due to fly soon. It will be powered by four 400 s.h.p. Turboméca Turmo II shaft turbines.

was largely because we had gone in for the sort of facility that was represented by the new test plant which he was going to open.

Later when Sir Geoffrey performed the opening ceremony he turned a key which initiated a test run on a Thor ramjet at conditions equivalent to Mach 2 at 50,000 ft. The engine was ignited at a "low altitude" and within a minute the cell depression had been increased to the maximum for the test—with the engine at 50,000 ft. And so efficacious was the silencing system that in the control building there was practically no sonic evidence that a ramjet was, in fact, being tested.

This important plant will accommodate ramjet units up to about 26 in. in diameter and, if necessary, could be used to test small supersonic turbojets. The maximum speed and altitude conditions it can simulate are M=3 and 100,000 ft.

Gliding in Space

A LONG-RANGE piloted rocket glider was proposed by a member of the Ryan Aeronautical Co. at a recent U.S. symposium on high-speed aerodynamics and structures. It would travel at near-satellite speed and circumnavigate the World, returning to its launching point.

This hypersonic glider, it was explained, would be launched from a sled travelling on a rail two miles long. Accelerated at 1*g* by rockets fired in sequence, it would take off at 500 m.p.h. and climb steeply to 100,000 ft. under its own liquid-fuel rocket power. After climbing less steeply to 200,000 ft., where its rocket fuel would be exhausted, the glider would enter a ballistic trajectory at 15,000-18,000 m.p.h. Nozzles in the wing would enable the pilot to correct aircraft attitude during this phase of the flight.

Aerodynamic controls would become effective when the glider slowed down to 2,000 m.p.h. at about 100,000 ft., enabling the pilot to make a conventional landing at subsonic speed.

The proponents of this scheme claim that the "slingshot" launching technique used would eliminate the vast amount of internal fuel needed to get a tail-sitter rocket off the ground and would save a great deal of weight. And the Ryan structures engineer who proposed this development explained that such a vehicle would be capable of "exploring space dynamics and the reactions of man to space environment." It would bridge the research gap between aeronautics and astronautics.

Guided Weapons and Aeronautics

A TIMELY summing-up of the impact of guided weapons on the concept of air power and on the field of aeronautics as a whole was given in a lecture to the Royal Aeronautical Society on April 10 by Mr. R. Cockburn, C.B., O.B.E., Controller of Guided Weapons and Electronics at the Ministry of Supply. Military aircraft, he said, had always had an important influence on aeronautical progress and the trend and pace of development had been determined in a large measure by the operational requirements of the Royal Air Force. These requirements were undergoing a radical change. One of the factors contributing to this change was the emergence of the guided weapon; but even more important and fundamental in its effect was the nuclear warhead.

Mr. Cockburn concluded his lecture by saying that it was never wise to be too dogmatic about the future and it was particularly dangerous where technology was rapidly developing. On more than one occasion, he said, the attention of the Royal Aeronautical Society had been drawn to the apparent impossibility of progress beyond some theoretical limit only to have it proved wrong in practice shortly after. Usually the argument had been sound, but the assumption ill-founded. He emphasized that the survey he had given depended on the continued supremacy of the means of delivery and hence on the acceptance of the logic of retaliation.

"Engineers are somewhat wary of general theories or of long-term predictions," he went on, "but in an art as complex as aeronautics there is danger, in the absence of a clear technical strategy, of dissipating effort over too wide a field. Moreover, it may be 10 years before a new project becomes operational and design must anticipate the conditions which will then prevail.

"Scientific and technical developments can no longer be regarded as perturbations in an established environment. On the contrary they now govern the conditions under which we live and our whole economic future. Scientists and engineers cannot escape their responsibility for planning the allocation of their resources."

Indian Air Force Celebration

RECEPTIONS given by Group Captain and Mrs. Sri Hari are always most happy occasions. And that given by the Air Adviser to the High Commissioner for India on April 2 to celebrate the twenty-fifth anniversary of the founding of the Indian Air Force was particularly notable. Mrs. Pandit, the High Commissioner, was present and among distinguished guests were Marshals of the Royal Air Force Sir William Dickson, now chairman of the Chiefs of Staff Committee, and Sir Dermot Boyle, Chief of the Air Staff. As a Squadron Leader Sir William was in India at the time of the formation of the Indian Air Force.

There were Air Marshals Sir Richard Atcherley, A.O.C.-in-C. Flying Training Command and Sir Alec Coryton of Bristol Aero-Engines. Mr. Cyril Uwins, president of the S.B.A.C., was there with Mr. Edward Bowyer, the Director, and among representatives of the Ministry of Supply was Sir Cyril Musgrave, the Permanent Secretary; Sir George Nelson and Mr. H. G. Nelson were among the guests. We saw too Mr. and Mrs. Edward Petter, of Folland Aircraft, makers of the Gnat fighter which is to be built under licence in India.

There were so many more guests that the fine panelled hall at India House was at one time difficult to move in. Throughout the evening the officers of the I.A.F. and their ladies were the most charming of hosts.

News of Aircraft, Engines and Missiles

SUPERIOR SAILPLANE.—Following tests of the EoN Olympia 419 sailplane at Twinwood Farm, Beds, over the Easter holiday the B.G.A. has announced that this aircraft "has a higher absolute performance than any other sailplane designed and built in this country."

RUSSIAN REPOWER.—Mil Mi-1 and Mi-4 helicopters may be re-engined with shaft turbine powerplants to improve performance and increase load capacity.

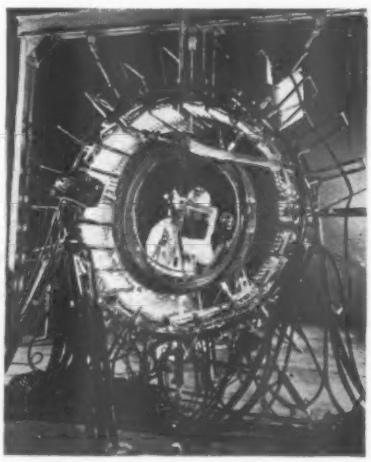
GOOD DOG.—Human voice commands have been used to control missiles by the Martin Co. This technique may be used for the Martin Bullpup air-to-surface weapon for the U.S. Navy.

MIXED MAIDEN.—First flight of the Aerfer Ariete mixed-powerplant fighter has been made at Practica di Mare.

U.S. RECOGNITION.—During a recent visit to this country Mr. Louis Morda, of the U.S. Dept. of Commerce, presented two American certificates in respect of British products. One was to Alvis, Ltd., which received American Civil Aeronautics Type Certificate No. 299 for the Leonides 502/8, 503/8 and 504/8 engines. It was accepted by Mr. J. J. Parkes, the company's managing director. Sir John Evetts, managing director of Rotol, Ltd., received an airworthiness certificate in connection with Rotol propellers used on Viscount 812 aircraft in the U.S.A.

ZERO LAUNCH.—A solid-propellent rocket has been used for zero-length launching of a North American F-100D Super Sabre at Edwards A.F.B. Take-off weight was 33,000 lb., with no external stores carried, and the launching angle was 20°.

PROTEUS LIFE.—An overhaul life of 1,300-hr. has been approved by the A.R.B. for the Bristol Proteus 705 turboprop engines of Bristol Britannia 100s in service with B.O.A.C. When Britannias were introduced on February 1, 1957, the Proteus overhaul life was 500 hr. Approval for the new life was given on March 19 when 175,000 engine flying hours had been completed.



X-15 TESTING.—Simultaneous heating and cooling of a metal ring representing part of the North American X-15 fuselage is part of the testing procedure for what may be the first manned satellite. Heating of the ring is by an array of infra-red lamps, while cooling is by cold air.

Photograph copyright "The Aeroplane"

EP.9 DUSTER.—The first Edgar Percival EP.9 for Crop Culture, Ltd., has a new dusting venturi under the fuselage.

MORE MAGIC.—Work on the Wizard anti-missile missile project is to be restarted. The Wizard weapons system is being worked by both Convair-RCA and Lockheed-Raytheon. About $72 million has been allocated for the Wizard programme in the 1959 financial year.

LATEST VERTOL.—The prototype of the Vertol Model 107 civil helicopter is due to fly this month. Developed from earlier tandem-rotor designs the Model 107 has two 825-s.h.p. Lycoming T53 shaft-turbine engines and can seat 20 passengers.

CLIMB RECORD.—On March 31 at Istres, a Sud-Aviation Trident II reached a height of 49,200 ft. in 2 min. 50 sec. from release of brakes. In addition to two Turboméca Gabizo turbojets at the wing tips the Trident has an S.E.P.R. 631 rocket which gives a thrust of 6,732 lb. at sea-level and 7,524 lb. at 65,600 ft.

MANNED SATELLITE.—Gen. Curtis E. LeMay is said to be backing plans for a manned satellite to be put into orbit by 1959, at a cost of $170 million. The vehicle would be a manned capsule in a rocket rather than the "escaping aeroplane" type (X-15). The capsule would orbit the Earth several times before re-entry into the atmosphere.

RAMJET POTENTIAL.—According to Roy Marquardt, the ramjet-powered Boeing Super Bomarc may fly at three times the present Mach 2.5 speed of the Bomarc, allowing the new version to attack targets outside the Earth's atmosphere. Marquardt ramjets include the RJ43-MA-3 (XIM-99A Bomarc) and the RJ43-MA-7 (XIM-99B Super Bomarc). New engines are the RJ57 and RJ59; a nuclear ramjet is being studied.

TITAN DETAILS.—According to a report from America the Martin Titan ICBM has three stages and three rocket engines. The first stage has two rockets, the second stage one rocket; the final stage is unpowered because its re-entry into the atmosphere is easier if no rocket section remains attached.

KAMAN VTOL.—The Kaman K-16 VTOL twin shaft-turbine-powered aircraft, under development for the U.S. Navy, will probably have General Electric T58 powerplants.

AUSTRALIAN EXPANSION.—Hawker Siddeley Group interests in Australia have been widened; Hawksley Australia Pty., Ltd., of Melbourne and Sydney, has acquired three manufacturing and contracting firms. They are the Bronze Window Frame Co., of Melbourne; James S. Samson, Pty., Ltd., and the Pacific Electric Co., both of Sydney.

CANBERRA CUTBACK.—Orders for the English Electric Canberra PR.9 built by Short Bros. and Harland in Belfast have been reduced by the Ministry of Supply.

SECOND JETSTAR.—The second prototype of the Lockheed Jetstar executive aircraft made its first flight on April 3, flying from Burbank to Edwards A.F.B., Calif. The first aircraft is to make a tour of military bases in the U.S.A. this month.

ONE-MAN MOUNT.—Developed by De Lackner Helicopters of Mount Vernon, New York, is this flying platform powered by a 40-h.p. Mercury Mk. 55 outboard engine.

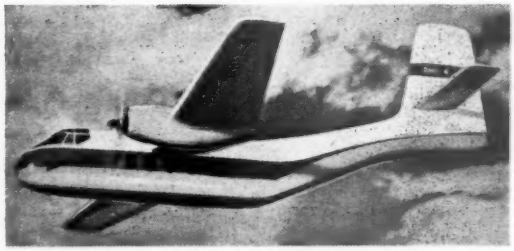
GOODWOOD AIRSTRIPS. — A licensed aerodrome has been established within the motor-race circuit at Goodwood and is available on race days. It has two grass strips: 034°/214°T, 2,300 ft. by 150 ft., and 098°/278°T, 2,280 ft. by 150 ft. The co-ordinates are 50°.52′ N; 00°.46′ W; 100 ft. A.M.S.L. The aerodrome was officially opened on Easter Monday, when the Tiger Club gave a display. (Picture, page 495.)

FAST ARROW.—On its third flight, the Avro Aircraft Arrow new all-weather fighter for the R.C.A.F. is reported to have exceeded the speed of sound. It made its maiden flight on March 25 (see THE AEROPLANE for April 4).

U.S. MOON ROCKETS.—Three "lunar-probe" rockets are to be launched by the U.S.A.F. and two by the U.S. Army. They will carry "mechanical ground scanners" and instruments to transmit topographical information about the Moon back to Earth. The U.S.A.F. will use three-stage rockets; the first stage will be the 150,000-lb. thrust Thor booster engine, the second will be the Vanguard second-stage rocket, and the third stage will be specially developed. Modified Jupiter-C rockets will be used by the U.S. Army.

BIPLANE PRODUCTION. — The Grumman agricultural biplane (THE AEROPLANE, December 13, 1957) is going into production and will be available by July. It has a 220-b.h.p. Continental uncowled radial engine, carries a 1,000-lb. payload. Stalling speed is 28 m.p.h.

ATTACK MISSILES. — In ground-attack trials a Fiat G.91 light tactical aeroplane will be fitted with two Nord 5103 missiles. This weapon was originally developed by Nord-Aviation as an air-to-air missile.



CANADIAN MOD.—Final configuration of the DHC-4 Caribou is shown by this model of a commercial version. Single vertical tail, replacing the original twin tail, is less tall than at first planned. The prototype Caribou will fly this year.

LATEST CRUSADER.—The Chance Vought F8U-2 is the latest version of the Crusader (see picture on page 522). It has a Pratt & Whitney J57-P16 turbojet, improved fire-control system and radar, and will carry Sidewinder air-to-air missiles. New features are a pair of fins under the tail and two air scoops, for afterburner cooling, on the tail-cone above the tailplane.

TURBULENT NEWS.—The second Turbulent built by Rollasons, of Croydon, G-APIZ, made its first flight on April 2. It has been bought by Miss Joan Short of Cambridge, a member of the Tiger Club, and is in all respects similar to the first aircraft except that it has a fuller instrument panel. Rollasons now have another four Turbulents in various stages of construction.

EVIL BORER.—Gimlet is the name of a new air-launch missile being developed by the U.S. Navy.

RESURGENT. — Phoenix Aircraft, Ltd., has been formed by Mr. C. H. Latimer-Needham and Mr. Arthur W. J. G. Ord-Hume to develop the designs of the old Luton Aircraft Co. and to produce new ultra-light aircraft, including a redesigned Luton Minor. The address of the company is Cranleigh Common, Cranleigh, Surrey.

MISSILE SYSTEM.—Named Azusa, a new telemetry system for missiles has been developed by Convair in connection with the Atlas ICBM programme. Azusa couples a ground transmitting station with a small transmitter/receiver (transponder) carried by all ballistic missiles launched at Cape Canaveral. Exchanges of signals give continuous data in position and speed of the missile, a computer working out from these the impact point from whenever the power is cut. Microwave signals from the ground are received by the transponder, modified and rebroadcast to the ground station for analysis.

SUPER ATAR.—Latest turbojet from S.N.E.C.M.A. is the private-venture Super Atar 26 designed for operation at Mach 3.0 with 18,000-lb. thrust.

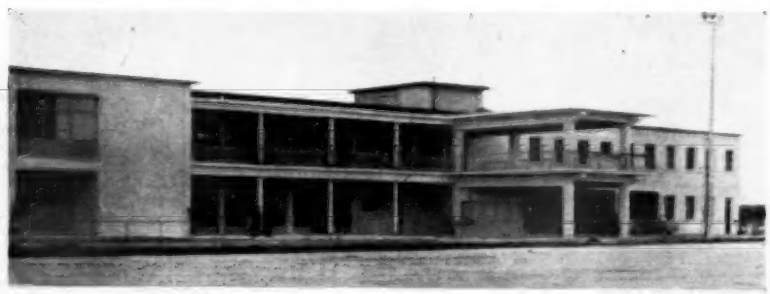
TIGER FINS.—Two retractable ventral fins are extended when the undercarriage of the Grumman F11F-1F Tiger is retracted. These give extra effectiveness in directional stability for certain critical manœuvres, presumably in yaw at high angles of attack. The Lockheed F-104A Starfighter has a fixed ventral fin.

Commercial Aviation Affairs

COMET 4 ROLL-OUT.—The first production de Havilland Comet 4 for B.O.A.C. was to be rolled out of the erecting shed at Hatfield this week, after this issue went to press. It should begin its flight trials at the end of the month. Among operators reported to have a positive interest in the Comet 4 at present are Tasman Empire Airways and Aerolineas Argentinas.

AMERICAN RESULTS.—Although the total revenue of American Airlines in 1957 broke all previous records, net earnings were down by 40% because of increased costs and lower load factors. Revenue increased by 4.9% over 1956, and costs (exclusive of federal taxes) went up by 13.4%; American carried over 8 million passengers and sold more than 5,000 million passenger-miles. The company plans to introduce Boeing 707s on its transcontinental routes by the end of 1958.

TOP THREE.—Figures issued by the C.A.B. show that American Airlines maintained, in 1957, their lead among U.S. operators for passenger-miles flown, with 5,142,594,000. They were followed by United with 4,868,310,000 and Eastern with 4,835,317,000. For the first time for many years, American were beaten into first place by Eastern in terms of passengers carried, respective figures being 7,649,153 and 8,145,138.



MALTA TERMINAL.—The new terminal building at Luqa Airport, which was opened by the Governor of Malta, Sir Robert Laycock, on March 31.

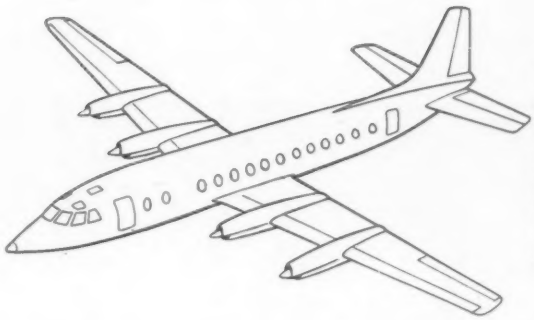
ROTORSTATION STUDY.—Applications to the L.C.C. for permission to build helicopter landing sites on the Thames, made by Rotorports Ltd. and Westland Aircraft Ltd., are to be considered at public inquiries at the County Hall on May 8 and May 15 respectively.

BACK TO BRISBANE. — Qantas resumed service at Brisbane after 16 years on April 3. One Super Constellation service between London and Sydney in each direction will call at Brisbane each week in future.

TU-104 BAN. — Following noise-level tests, the French authorities have refused permission for the Tu-104 to operate at Orly Airport. The ban follows a request from C.S.A. to introduce Tu-104As on their Prague-Paris service.

NEW IATA MEMBER.—Trans Caribbean Airways has been admitted to associate membership of IATA. Trans Caribbean operate scheduled services between New York and San Juan, Puerto Rico.

AEROQUAYS AT WINNIPEG.—A new terminal building at Winnipeg Airport, on which work will start this year, will feature the "aeroquay" or apron satellite building arrangement which has also been adopted for Los Angeles International and Montreal. There will be a central passenger building with three islands connected by 600-ft. subways.



ARC IN THE SKY.—Republic Aviation are continuing to assess airline interest in their Rainbow project which weighs 77,500 lb. and uses four Rolls-Royce Dart R.Da. 10s or General Electric T64s. This sketch shows the resemblance to the Viscount, including elliptical windows.

EAGLE TO PALMA.—Eagle Airways' new Birmingham-Palma service, which had to be postponed because of Spanish Government objections, will now be introduced as a once-weekly inclusive tour scheduled service. Bookings will be restricted to tourists who must return 14 days after the outward journey.

ANOTHER VISCOUNT. — The Canadian Department of Transport has ordered a second Vickers Viscount (700 series) to supplement that delivered to the Department in March, 1955, and used for Government visits abroad and for internal communications.

SKYWAYS LOSS.—The crew of three were killed when a Skyways Hermes on a local test flight from Stansted crashed on April 1. They were Capt. Rayment, who was the company's chief test and training captain, Capt. West and Engineer Officer Bradley.

CHANNEL COACH - AIR. — Air Charter inaugurated their Coach-Air services to Calais, Ostend and Rotterdam on April 1. Coaches carry passengers from Euston to Southend, and there are coach and train connections from Calais to all parts of Europe. In the summer peak Air Charter will fly 108 services a day on their three Channel Air Bridge routes, including 70 between Southend and Calais, providing for 1,100 passengers and 420 cars a day. All services are flown by Bristol 170 Freighter 31s and 32s.

VISCOUNT ACCIDENT.—On the night of April 6 a Capital Airlines' Viscount 745 crashed during final approach to Tri-City Airport, Saginaw, Michigan, about 2,300 feet short of the runway threshold. All 44 passengers and the crew of three lost their lives. The aircraft was flying on the Newark (N.J.), Detroit, Flint, Saginaw (Tri-City) and Chicago run. This is the first fatal accident to a Capital Viscount since the type went into service with the airline nearly four years ago. At the time of going to press no information was available about the possible cause of the accident.

News About People

ANGLO-FRENCH AWARD. — The Louis Breguet Trophy for 1957 has been awarded to Mr. Raoul Hafner, chief designer (helicopters), of Bristol Aircraft, Ltd., for his achievements—"many and of great value"—in the helicopter world. The Trophy, presented to the R.Ae.C. by Sir Richard Fairey, commemorates the work of Louis Breguet and is awarded for meritorious achievement in the development of aircraft that substantially achieve the advantages offered by rotating-wing aircraft.

T.C.A. IN BELGIUM.—Mr. A. Patten Wilson, who has been T.C.A.'s European agency and interline sales manager since 1952, has been appointed manager for Belgium. He will also be responsible for the Netherlands and Luxembourg.

AVIONS DRUINE. — Mr. Harold Best-Devereux informs us that he has been appointed by Mme. Druine, widow of M. Roger Druine, whose death we recorded last week, to act on her behalf in English-speaking countries to ensure the continued availability of drawings of Druine aircraft. He can be contacted c/o the P.F.A., at 19 Park Lane, London, W.1.

PRIVATE SECRETARY.—Mr. A. J. Rosenfeld has been appointed private secretary to Mr. Airey Neave, joint parliamentary secretary to the M.T.C.A.

PRODUCTION DIRECTION. — Mr. H. S. Butt, O.B.E., has been elected to the board of Dowty Equipment, Ltd., as production director.

B.A.C. RETIREMENT.—Mr. George Boex, a former managing director of the British Aluminium Co., Ltd., and its associated companies, retires from the board in May. He will however continue to act as a consultant.

WOLVERHAMPTON POSTS.—Mr. G. C. Haynes, A.C.A., director and secretary of Boulton Paul Aircraft, Ltd., has been appointed deputy managing director of the company. Mr. G. A. Woolsey, A.C.A., previously chief accountant, has been appointed secretary.

INDIAN VISIT.—Mr. J. N. Toothill, general manager of the Scottish Group of Ferranti, Ltd., which is responsible for the development of aircraft radar and fire-control equipment, is visiting India. During his three weeks' stay he will meet Government officials and Indian Air Force officers.

AERO GOLF.—The Aero Golfing Society played its annual match against the R.A.F. Golfing Society at Wentworth on March 28. The morning foursomes were won by the A.G.S. by 7 matches to 5; the R.A.F. won the afternoon foursomes by 7½ matches to 4½, thus winning the day by one match.

R-R LIAISON OFFICER.—We regret to record that Gp. Capt. R. J. M. de St. Leger, R.A.F. (Retd.), died at Halton on March 28. He had been with Rolls-Royce, Ltd., at Derby as the company's liaison officer since 1953. He learnt to fly with the R.N.A.S. in 1914 and took a short service commission in the R.A.F. in 1921. In 1926 he received a permanent commission.

Military Aviation Affairs

SWISS HUNTERS.—The first of 100 Hawker Hunter Mk. 6s ordered by the Swiss Air Force was flown from Dunsfold to Emmen, Lucerne, on April 3, taking 54 min. for the 517-mile flight and averaging 575 m.p.h. It was flown by a Swiss test pilot, Hans Hafliger.

R.A.A.F. APPOINTMENT. — Maj. H. M. Sealy, U.S.A.F., has been posted to command No. 75 Sqn. equipped with Sabres at R.A.A.F. Williamtown. One of the U.S.A.F.'s senior jet fighter pilots, Maj. Sealy has logged 3,000 hr. in 18 years' service.

NAVAL PILOTS.—The first "wings" parade at No. 1 F.T.S. since its transfer to R.A.F. Linton-on-Ouse at the end of last year was held on April 3. Training Naval air pilots, No. 1 F.T.S. is at present the only R.A.F. flying school where both basic and advanced training is in operation at one station.

R.A.F. BENEVOLENT FUND.—Gp. Capt. R. T. Taaffe has succeeded Gp. Capt. A. ap Ellis as secretary of the Republic of Ireland branch of the R.A.F. Benevolent Fund. Until 1956 Gp. Capt. ap Ellis was also secretary of the Northern Ireland branch.

GAN STAGING POST. — Pending negotiations between the United Kingdom and the Maldivian Parliament, all work on the R.A.F. staging post on Gan in the Maldive Islands has stopped. Imported labour gangs, including Ceylonese and Pakistani workmen, are now idle following the rejection of the three British offers for an agreement.

R.C.A.F. ASSISTANCE.—An advisory group of 40 personnel from the R.C.A.F. Air Division in Europe is to be attached to the West German Air Force to assist in the operational training of its Sabre pilots. Germany has received 75 Sabre 5s from Canada as a Mutual Aid contribution and has purchased 225 Mk. 6s from Canadair.

FIREPOWER TESTS.—A full-scale display of U.S. Navy air armament, including simulated nuclear weapon drops, will be given at the third Annual U.S. Naval Air Weapons Meet held at El Centro Air Station, Calif., between April 14 and 18. Aircraft to be used in the air-to-air and air-to-ground competitions include Douglas A3D Skywarriors, F4D Skyrays and North American FJ-4 Furies.

AIR TRANSPORT

L.A.P. and Prestwick Developments

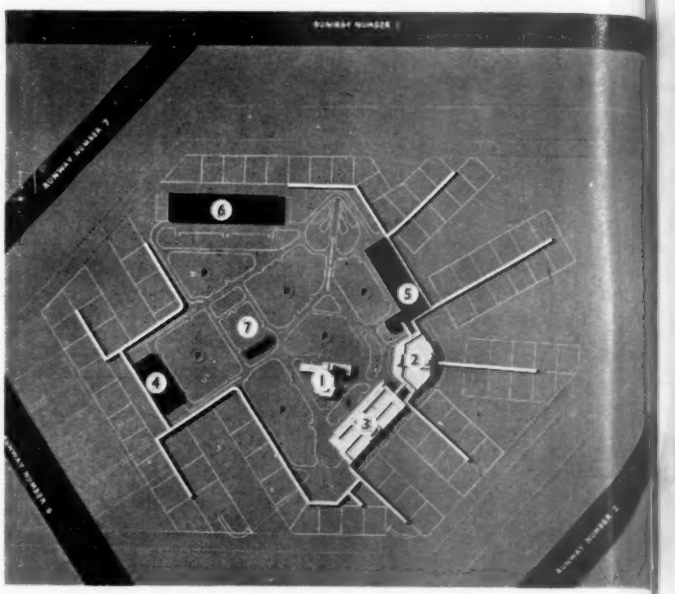
ON April 2 the Minister of Transport and Civil Aviation announced in the House of Commons the decision to accept as a "framework" the recommendations of the Millbourn Committee for the development of London Airport (THE AEROPLANE, August 9, 1957, pp. 178-180).

Mr. Harold Watkinson said that the first phase would be the laying-down of additional aircraft-stand areas. Designs, he said, were well advanced for the new long-haul terminal building in the central area, which should be ready, at least in part, within the next two or three years.

Afterwards, in answer to another question, he said that it had been decided in principle that Prestwick should be developed with the lengthening of the main runway and the provision of a new terminal area.

Work has, in fact, been going on at Prestwick on a 500-ft. extension at the north-west end of the main 13/31 runway since early last month.

All this is considered locally to be no more than a temporary measure and the additional runway brings the length only to 7,500 ft. An extension to 9,500 ft. to the north-west will be possible without interference with the Glasgow-Ayr railway line, but it will be necessary, presumably, for the main road to be taken under the runway or diverted.



The layout proposed by the Millbourn Committee (referred to in the accompanying paragraph) for L.A.P.'s Central Area. It involves the abandonment of No. 4 runway, which is not shown on this plan. Key: (1) control and administrative building; (2) Queen's building; (3) S.E. face passenger building; (4) proposed long-haul terminal; (5) proposed new short-haul terminal; (6) proposed freight building; (7) fuel installations; (P) car parks.

Arthur Butler Resigns

THE contest between Mr. Reginald Ansett and Mr. Arthur Butler for control of Butler Air Transport came to an end last month, with the resignation of Mr. Butler as managing director. In February, Equity Court action in upholding the validity of proxy votes cast by Butler shareholders had the effect of making Mr. Ansett chairman of the company. He is reported then to have invited Mr. Butler to remain as managing director and to have paid the costs of the litigation. Following Mr. Butler's decision to resign, Ansett-A.N.A. have purchased his 12,925 shares in B.A.T., at 30s. each.

Capt. Stewart Middlemiss has been appointed chief executive of Butler Air Transport, with a seat on the board, and will perform the duties of managing director. He had recently been appointed New South Wales manager of Ansett-A.N.A., following service with Ansett Airlines in charge of flying-boat operation, and was the founder of Barrier Reef Airways.

Queensland Airlines, formerly a subsidiary of Butler Air Transport, has now been made a direct subsidiary of Ansett Transport Industries, while B.A.T. itself is apparently a subsidiary of Ansett-A.N.A. Mr. Ansett has therefore now gained complete control of a very large part of domestic Australian air transport operation outside the Government-owned T.A.A.

Route Service Charges

THE Montreal meeting of ICAO's Route Facilities Charges Conference ended last week-end, April 6. No unanimous agreement was reached about the desirability of charging airlines for all or any route facilities, but a majority was of the opinion that the burden on some governments was too great and that user charges would eventually be inevitable.

Certain general principles were laid down by the Conference. These were:—

There shall be no difference in charges between users, particularly between those of the nationality of the country supplying the facilities and others; charging systems should take into account both the actual cost of providing and operating the facilities and the effect of these charges on the finances of the airlines; charges should not be imposed for facilities not required or used and should not be imposed in such a way as to discourage the use of facilities necessary for safety or the introduction of new aids and techniques; the charging system should be as simple as possible.

The Conference considered that conditions varied too much on different routes and in different parts of the World for it to be possible to lay down any standard that would be reasonable for route facilities and services, or even any standard proportion of allocable costs that might reasonably be recovered. Each State must therefore use its discretion as to the level of any charges to be imposed.

THE MOVING FINGER.—United Air Lines is now using this telescopic "Aero-Gangplank" at Chicago's O'Hare Airport to link aircraft with the first-floor passenger concourse in the terminal building. The three-section ramp swivels through 120 degrees and is adjustable in height to fit snugly against the door of any aircraft type. It can be moved into position in 90 seconds.

A Lost Horizon?

FOR reasons which are not difficult to understand, the contestants in the verbal and statistical battle—which has been going on during the past three years over the re-equipment policy of the airlines—have tended to take sides on unnecessarily arbitrary and even ideological terms. The protagonists of the turbojet have, for instance, tended to lean over backwards to try to prove that there was no sense or future in the turboprop, and the turboprop enthusiasts have denied some of the very real prospects for the turbojet.

In fact, the true arguments for and against the present re-equipment trends have little or nothing to do with the direct technical, commercial, or passenger-appeal virtues of the two types of aircraft. They are (or should be) concerned solely with the question of the best way of keeping costs down and thus of encouraging the growth of air traffic and the greater prosperity of the airlines.

Now that the thoughts expressed in Mr. John Brancker's article ("A New Horizon," March 21, pp. 381-382) have been germinating in the minds of readers for three weeks, it might be a useful exercise to consider a few of the implications of the arguments and convictions stated in that article.

First of all, no critic—not even the most severe of Mr. Brancker's "frustrated nursery governesses"—has ever suggested that the airlines "should have carried on with existing types." All that the critics have suggested—usually in meek and even diffident terms—is that the airlines might be considered to have "ordered too much new equipment too soon."

In so doing, the critics say, the airlines have lost for themselves the chance of building up their traffic and developing their techniques in easier stages while using equipment which, though faster and more advanced than existing piston-prop aircraft, would not have demanded drastic changes in their operating environment. Meanwhile, the turbojets might have been introduced more gradually, first on the routes for which they were most obviously well-suited and only later—if all seemed well on the operating and economic fronts—elsewhere in the pattern.

As the turbojet buying situation developed, it was, to the minds of these critics, almost as if the airlines had forgotten one of the very first rules of commercial enterprise: never, unless you are absolutely sure, put all your eggs in one basket—and certainly not if the basket is being carried by more than one person.

There might have been plenty of good sense in the so-called equipment "buying spree" if the airlines had been fully solvent in the sense that they had been already paying for all the facilities provided—and if, better still, they had been in control of these facilities. But they were not; the success of a brave venture into the jet era depended not only on continued public prosperity, but also on the willingness of communities to provide the longer runways, the better navigational aids and the improved air traffic control systems without which the big turbojet transports would be unable to do everything that they were designed to do.

The specialist short-haul transport project suggested by Mr. Brancker is an excellent one. But if such a low-cost aircraft is practically possible—as many of us believe it is—then the short-haul turbojet does not altogether make sense except as a first-class or tourist-class vehicle. As such a vehicle, it makes a very great deal of sense—but neither the short-haul nor long-haul turbojet is likely to develop new traffic for the airlines.

So we are given, *ipso facto*, a cast-iron case for fare differentials related to speed and comfort. Mr. Brancker himself obliquely suggests that the use of his Super Coach might justify the approval by IATA of a lower fare for special types of operation.

Where do you draw the line? If lower fares are to be permissible for a specialist aircraft and specialist services, why not approve such fares for aircraft which are already in existence (or shortly to be so) and which are, in fact, cheaper to operate over at least certain stage lengths?

Anyway, no one will go to the expense of designing and manufacturing the Super Coach unless it is quite certain that such speed/comfort fare differentials are agreed in principle. Obviously, no one is going to travel in it if, for the same fare, they can be booked on a turbojet flight.

A blanket fare policy covering older and slower and newer and faster aircraft is patently ridiculous—and everyone knows that it is so. Everyone in the business knows, too, that the policy being maintained is, to use the old-fashioned vernacular, a "stick-up"—or, to be just as old-fashioned, that we are being "taken for a ride"—and an expensive one at that.

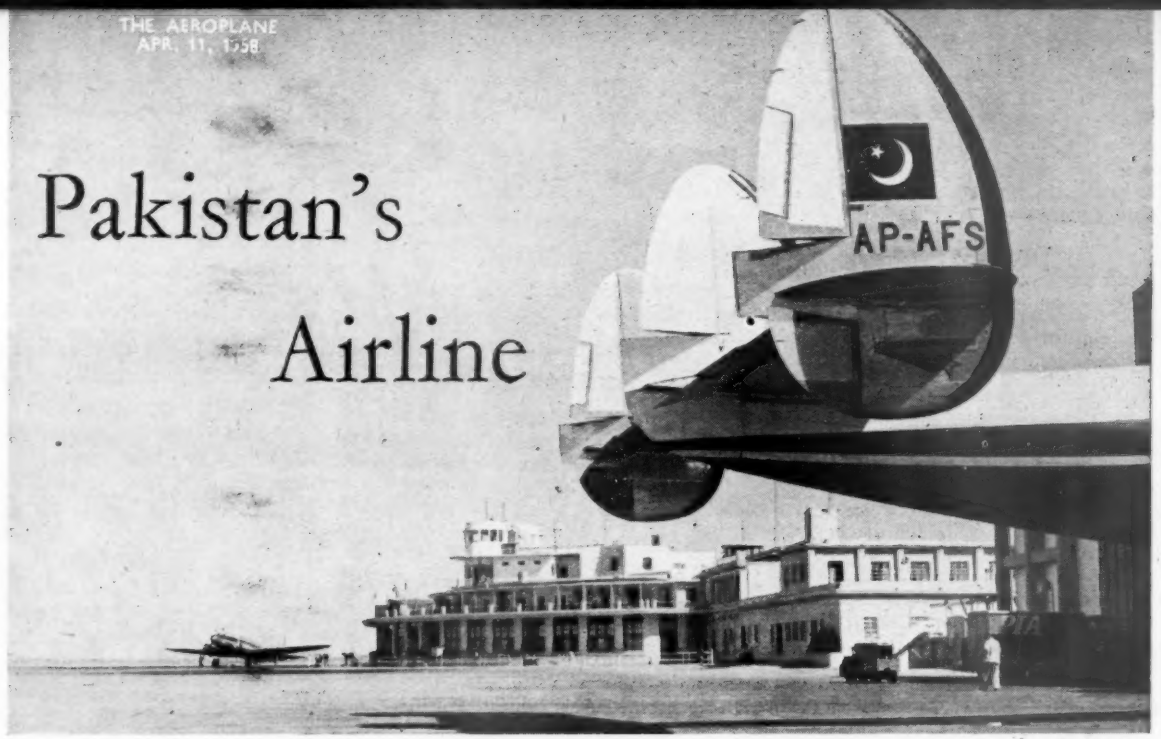
No one denies that the turboprop or piston-prop aircraft is cheaper to operate, even in ideal conditions, over certain short and possibly over some longer stages. And no one denies, either, that the turbojet aircraft (whether usefully faster or not over the shorter stages) will, other things being equal, attract most of the traffic which is to be purchased at a particular and fixed fare level.

It may be that, over a long period, the travelling public will decide that a turboprop service, though slower, is more reliable in its time-keeping, or, perhaps, statistically safer—but the period during which such a conviction can harden will be a very long one and the piston-prop and turboprop transports will have died long before such statistical facts can become apparent to a travelling public.

If this public is to have the chance of a lower-fare ride a decision in favour of differential fares must be made fairly soon. I think that it will be made, anyway, in the early 1960s—just as soon as the U.S. domestic carriers discover that they have a lot of out-dated and unsaleable equipment on their hands and wish, rather than sell it at scrap prices, to get a bit more work out of it.—H.A.T.

PERSIAN TERMINAL.—A Britannia recently visited Teheran in preparation for the resumption of B.O.A.C. services on April 22. It covered the 2,743 n.m. in 7 hr. 39 min. and is seen here in front of Mehrabad Airport's new terminal building, which is due to be opened later this year.

Pakistan's Airline



Karachi Airport.

IT was an extraordinary—but politically, racially and ideologically inevitable—situation which, in 1947, caused a new Commonwealth nation, Pakistan, to be geographically divided. But, since the two portions of the country—East and West Pakistan—were separated by a thousand miles or so of another new independent nation in the Commonwealth, the situation was one which gave air transport a really valuable, if not essential, job of work to do.

Within Pakistan there were formed Orient Airways, then Pakistan International Airlines, and finally a sensibly reorganized P.I.A., which has since done the work of both. A primary responsibility of Orient since 1950 and, later, of P.I.A., has been that of operating services between the two wings of Pakistan, but a great many local services have also been flown, and P.I.A. has been flying internationally to Europe since 1954—although the inter-Pakistan service must always have been the prime reason and justification for the national airline system.

At present, P.I.A. operates six non-stop services a week between Karachi and Dacca, in East Pakistan (a distance of 1,470 miles), and two a week between Lahore, West Pakistan, and Dacca. For such services the L-1049Cs have been invaluable. Not unexpectedly—since the alternative means of transport between the two centres is a 3,000-mile boat trip—the load factors on these services are high. They average between 83% and 85% and rise to 97% at peak periods.

The aircraft have mixed-class layouts and the tourist fares can be very low—working out at just under 2.86 U.S. cents per passenger-mile—because the Pakistan Government helps by paying the difference in the cost of the fares on this essential service. P.I.A. would like to operate a regular daily freight service over this route and would do so if a cargo payload of about 20,000 lb. a day could be guaranteed.

The run to Europe is now operated (since July, 1957) on a twice-weekly frequency. It does well in the westerly direction and the frequency may eventually be increased to four a week—but the main problem concerns the relatively low load factors in the easterly, London-Karachi, direction. Future long-haul plans include possible services to Sydney, Tokyo and Nairobi—when two more Super Constellations will be needed.

At present, P.I.A. have three L-1049Cs and may, by now, have taken delivery of a passenger-freight L-1049H. For short- and medium-haul work they have 10 DC-3s and four Convair 240s. One of the latter was damaged in a mid-air collision last Christmas Day and is being rebuilt. Three Viscount 815s are on order for delivery later this year.

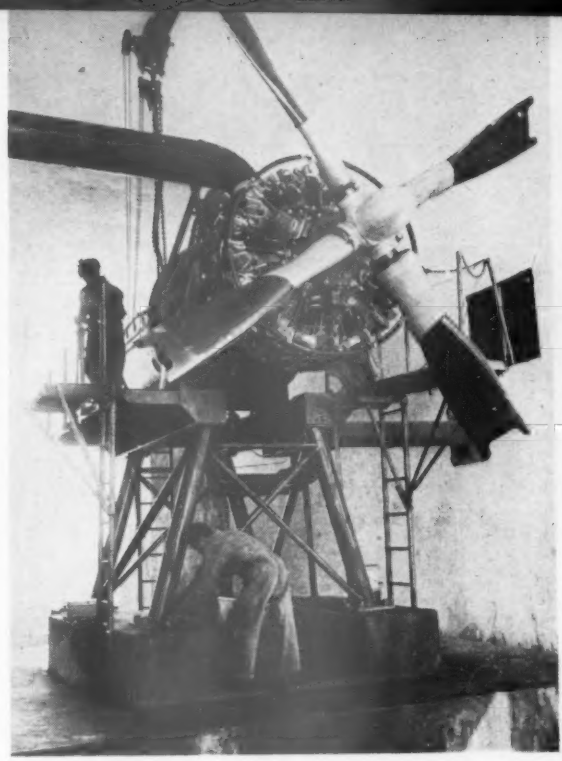
The P.I.A. route mileage is now about 11,000 and traffic continues to build up. There was a 46.5% increase in hours flown between 1956 and 1957 and a 53% increase in revenue aircraft-miles. Freight ton-miles increased by 60% and mail ton-miles by 27.5% between the first and second halves of 1957.

One of the most important developments has been P.I.A.'s increasing self-sufficiency in terms of engineering and maintenance work. In February, 1956, an R3350 engine was overhauled for the first time by P.I.A. and now all engine overhauls are completed in the shops at Karachi.

(*Continued on page* 503)

Engineers at work in the P.I.A. instrument section at Karachi Airport. Extensive new facilities have been built for all aspects of engine, airframe and accessory overhaul by P.I.A. at Karachi.

Photographs copyright "The Aeroplane"



This picture of an overhauled R3350 on its test-stand in the P.I.A. workshops indicates progress in self-reliance.

(*Continued from page* 502)

Important though the international and inter-wing services may be, the local operations are just as essential in their own way. For instance, between two and four DC-3 freighters are based at Rawalpindi for operations up the Indus Valley to Gilgit in Kashmir in the winter—when air transport provides the only means of supply. Another interesting service is that by DC-3s to Kandahar and Kabul—two a week are shared by P.I.A. and Ariana, the Afghan airline. At Kandahar, incidentally, the U.S. is building a 10,000-ft. runway for the Afghan Government, whilst the Russians are building the runway at Kabul.

Among the more routine scheduled operations are the services from Karachi and Dacca within the west and east wings of the country and from Karachi into India. More than 100 passengers a day are flown between Karachi and Lahore, Rawalpindi and Peshawar. From Karachi there is a daily flight to Bombay—with P.I.A.'s Convair competing, at present, with the Indian Airlines Corporation's Viscounts. At Dacca four DC-3s are based for local operations including the summer-season runs to Chittagong and Rangoon.

Since the summer of 1953 there have been 30 Pan American technicians in Pakistan on U.S. Government attachment. They are due to leave this year, but may stay for another 12 months, and are employed as part of the U.S. Technical Assistance Program. Including Mr. Hamilton Smith, Jr., who is project advisor to P.I.A., the team from P.A.A. has, in effect, been supervising, or checking, the work of the airline.

Considering Future Civil Aircraft

FUTURE trends in air transport were assessed on an operating-cost basis by Mr. G. H. Lee, deputy chief designer of Handley Page, Ltd., in a lecture before the Glasgow branch of the Royal Aeronautical Society on March 11. His conclusions about the cost of operating supersonic airliners were summarized in THE AEROPLANE of March 21.

Mr. Lee divided the direct operating costs for aircraft into two parts: the first depending on the fuel used and the second allowing for other costs such as maintenance, crew salaries and depreciation. These could be expressed as:—

$$\text{Fuel cost} = A \times \frac{\text{fuel used on given flight}}{\text{ton-miles flown}}$$

$$\text{Other costs} = B \times \frac{\text{basic weight} \times \text{time in air}}{\text{ton-miles flown}}$$

A and B were constants; A had the same value for all aircraft. The factor B had a value which was the same for supersonic and subsonic jet and turboprop aircraft; it was increased by 15% for the laminar-flow transport studied and by 20% for the VTOL aircraft. The basic weight in the second cost equation was aircraft all-up weight less fuel and payload.

The values of A and B were decided by matching operating costs, calculated by the system described, to the corresponding costs calculated in detail by the S.B.A.C. method. In both cases these costs were for a 210,000-lb. jet airliner cruising at 550 m.p.h.

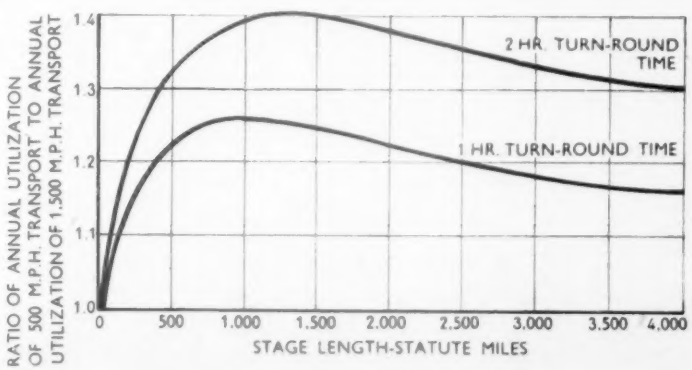
Using a cost formula which resulted when the two cost equations above were added together, Mr. Lee compared the merits of the following transports:—

Type of airliner	Cruising speed	Range parameter *
Turbojet	550 m.p.h.	11,000
Turboprop	400 m.p.h.	12,000
Supersonic delta	1,500 m.p.h.	7,000
Laminar-flow	550 m.p.h.	19,000
Tilt-wing VTOL	300 m.p.h.	6,000

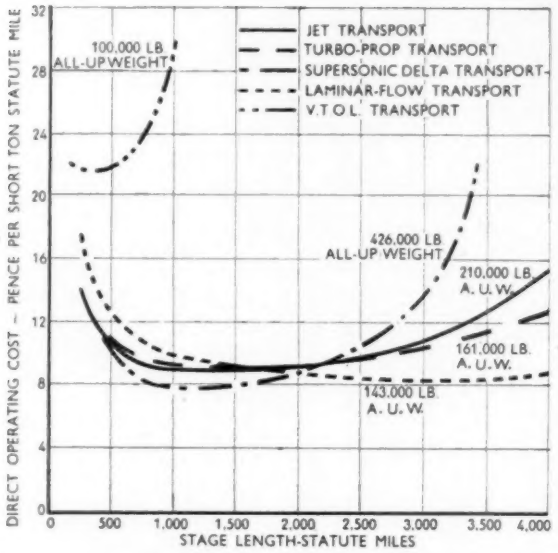
* The range parameter $= \frac{L}{D} \times \frac{V}{C}$, where $\frac{L}{D}$ is the lift/drag ratio, V is ground speed in m.p.h. and C is specific consumption in lb./lb. of thrust/hr.

In calculating costs, allowance was made for a headwind of 25 m.p.h. Flight time was taken as that needed to cover the stage distance at the cruising ground speed plus 45 minutes. The additional 45 minutes is the allowance for take-off, climb, descent and stand-off.

Costs were compared in two ways. In the first they were



Based on a 15-hour day, these curves show how the utilization of a 1,500-m.p.h. transport is reduced because in making more journeys per day it spends more time on the ground at terminal airports.


JET TRANSPORT
TURBO-PROP TRANSPORT
SUPERSONIC DELTA TRANSPORT
LAMINAR-FLOW TRANSPORT
V.T.O.L. TRANSPORT
100,000 LB. ALL-UP WEIGHT
426,000 LB. ALL-UP WEIGHT
210,000 LB. A.U.W.
161,000 LB. A.U.W.
143,000 LB. A.U.W.
DIRECT OPERATING COST — PENCE PER SHORT TON STATUTE MILE
STAGE LENGTH-STATUTE MILES
0 4 8 12 16 20 24 28 32
0 500 1,000 1,500 2,000 2,500 3,000 3,500 4,000

Operating costs are compared for a series of aircraft designed to carry a 32,000 lb. payload; the design stage range, except in the case of the VTOL transport, is 3,000 miles. No allowance is made for the aircraft carrying a payload greater than 32,000 lb. over shorter stages.

based on aircraft designed to carry a 32,000-lb. payload over a 3,000-mile stage distance; allowance was not made in the curves for the greater payload which could be carried over shorter distances. In the second case costs were also shown for aircraft which carried a 32,000-lb. payload, but for which the all-up weight was not constant. For ranges under 3,000 miles lighter aircraft would be designed to carry the 32,000-lb. payload; the curves allowed for this factor.

Mr. Lee pointed to the relatively small increase in costs with the supersonic airliner—some 25%, although cruising speed is well-nigh trebled. In practice, costs would be further increased by 3% as utilization was reduced for supersonic airliners; they made more journeys per day and thus the turn-round time was greater. The effect of this on utilization is shown on the graph on the previous page.

The Future

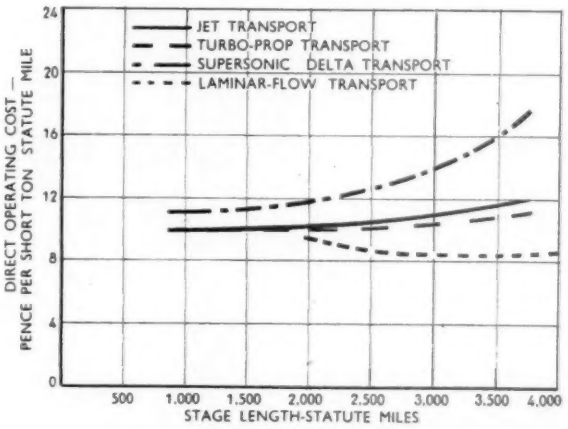
Surveying the future, Mr. Lee saw a fruitful field for the 1,500 m.p.h. supersonic airliner. Making a stop at Gander, it could cross the Atlantic in less than 4½ hours, compared with the 7¾ hours of the new jet airliners. Although its direct operating costs might be 25% greater than those of current jet airliners, these costs would be greatly lowered if the design came out only slightly better than planned. It was essential, he said, that we should build such an airliner.

For ranges up to 2,000 miles there was little to choose, in the matter of costs, between the turboprop and the jet airliner. For greater ranges up to 4,500 miles there was a case for both turboprop and laminar-flow aircraft.

For feeder routes small jets were suitable unless aerodromes were small; in this case turboprops were best. STOL aircraft could be vital for under-developed countries, but there was little need for them in developed regions.

VTOL aircraft, although expensive to operate, were needed for operation between city centres up to 400 miles apart; they would have to cruise fast if they were to remain competitive with the 500-m.p.h. short-range jet airliners. Mr. Lee foresaw little increase in speed above 1,500 m.p.h. This speed, equivalent to a Mach number of 2.25, was a "cost and range optimum."

Another future prospect was nuclear power. The poor lift/drag ratios of supersonic flight appeared to rule out supersonic nuclear aircraft. But laminar-flow aircraft, with their high lift/drag ratios, were ideally suited to nuclear powerplants which, owing to their shielding, have a very low power-to-weight ratio. Using laminar-flow techniques the all-up weight of a nuclear aircraft could be 300,000-400,000 lb.; a "normal" nuclear aircraft would weigh well over 500,000 lb.


JET TRANSPORT
TURBO-PROP TRANSPORT
SUPERSONIC DELTA TRANSPORT
LAMINAR-FLOW TRANSPORT
DIRECT OPERATING COST — PENCE PER SHORT TON STATUTE MILE
STAGE LENGTH-STATUTE MILES
0 4 8 12 16 20 24
500 1,000 1,500 2,000 2,500 3,000 3,500 4,000

This cost comparison is for aircraft carrying a 32,000 lb. payload. All-up weight varies so that costs at each stage range are those for an aircraft designed to fly over that range.

Aircraft Performance and the Airlines

AMONGST the interesting practical points made in the appendix to Mr. B. S. Shenstone's British Commonwealth Lecture (March 28 issue, p. 412, and last week's issue, pp. 461 and 463) some of the more potent were those in the section dealing with aircraft performance and guarantees to the airlines.

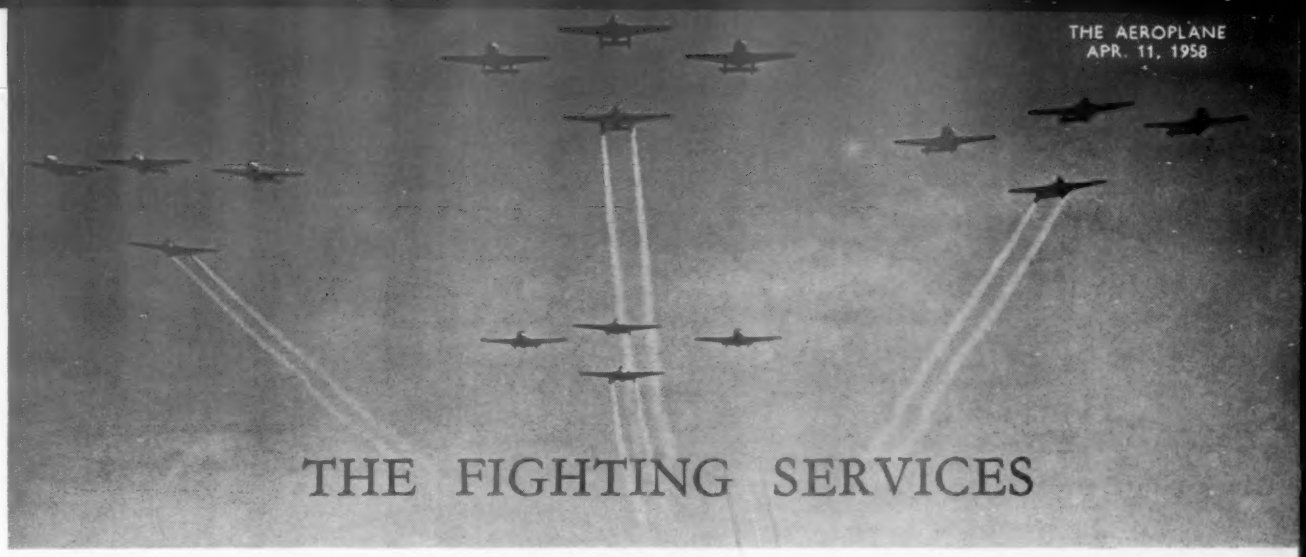
Pointing out that manufacturers' guarantees still quote "estimates plus or minus a fairly hefty tolerance" and that the results usually managed to be "at or near the minimum value," Mr. Shenstone goes on to say that an airline is interested primarily in fulfilling what it has planned to do; that plus and minus tolerances are of no value; and that guarantees should be worded in terms of "not less than" (for speed, payload and range) or "not more than" (for field lengths and fuel consumptions).

"In the event," he continues, "of non-compliance with a guarantee it is almost impossible to attach a realistic penalty since potential earnings, and hence loss of earnings, may be very large compared to the first cost of the aircraft. . . . As examples, a single jet airliner can lose £6,000 a year from 100 lb. loss of maximum payload, or from a loss of 2% on block speed.

"Poor take-off or landing performance is unlikely to affect more than a small proportion of an operator's routes, but such services may be key ones, where a certain amount of payload must be taken. If this is the case, the number of services may need to be increased and the number of aircraft required may be affected. However, even assuming that only 2% of all take-offs are critical, a deficiency of 10% on take-off or landing distance required might cause a loss of the order of £3,000 per aircraft per year.

"Manufacturers have tended in the past to concentrate on providing performance information to obtain a Certificate of Airworthiness and to demonstrate compliance with guarantees. Airlines wish to see more emphasis placed on getting tests done and analysed to produce realistic data in good time for scheduling with *recommended engine* conditions. These may differ from the guarantee conditions, and in any case cover a wider range of weight, altitude and temperature conditions."

Dealing with variability of performance, Mr. Shenstone says: "The margins introduced in flight planning data, to ensure reasonable probability that the planned performance will be achieved on any given occasion, are becoming of increased importance for aircraft operating at optimum altitudes near ceiling conditions. The planned cruise altitude will have to be rounded off below the optimum in many cases to suit quadrantal heights, but there may be a further reduction to cover variability; any steps which can be taken to reduce variability will enable the aircraft to operate nearer to its optimum condition."



THE FIGHTING SERVICES

Senior R.A.F. Postings

APPOINTED Director of Operations (Fighter and Theatre Air Forces) at the Air Ministry with effect from May 12 is Air Cdre. P. G. Wykeham, D.S.O., O.B.E., D.F.C., A.F.C., A.F.R.Ae.S., who has been Air Commodore in charge of operations at Headquarters, Fighter Command, since July, 1956.

He has been in the Service since 1932, when he joined as an aircraft apprentice, and he passed out from Cranwell to become a fighter pilot in 1937. He served throughout the War in Europe and North Africa and afterwards held appointments at the Air Ministry, the Ministry of Supply, Fighter Command and Allied Air Forces, Central Europe, and then in Korea as adviser to the U.S.A.F.

Group Captain T. B. de la P. Beresford, D.S.O., D.F.C., is to become Air Commodore in charge of Operations at Headquarters, Fighter Command, this month, with the acting rank of Air Cdre. Commanding No. 233 Operational Conversion Unit, R.A.F. Pembrey, from 1952 until he became Air Adviser to the United Kingdom High Commissioner in India in September, 1954, Gp. Capt. Beresford is at present Group Captain in charge of Operations at Fighter Command.

A.T.C. Gliding Activities

A REVIEW of gliding activities by the Air Training Corps during the 12 months ended February 28 reveals that a total of 4,610 hr. was flown, and there were 56,911 launches with 121 gliders.

This effort resulted in the award of 1,195 proficiency and 42 advanced gliding certificates to cadets, who also made 5,176 solo flights. During the same period a further 9,616 launches were made in the training of A.T.C. volunteer gliding instructors —members of the R.A.F.V.R. (Training) and civilians—of whom there are now about 200.

All of these activities took place at the one whole-time school (at Hawkinge) and at 20 week-end schools in the U.K., which are at Swanton Morley, Martlesham Heath, Halton, Hornchurch, Kenley, Weston-super-Mare, Christchurch, White Waltham, Exeter, Hawarden, Meir, Cosford, St. Athan, Usworth, Rufforth, Kirton-in-Lindsey, Spitalgate, Bishops Court, Dumfries and Edzell.

A.O.C., Gibraltar

GROUP CAPTAIN R. B. THOMSON, D.S.O., D.F.C., is appointed Air Officer Commanding, Gibraltar, as from May 12, with the acting rank of Air Cdre. Since April, 1955, he has been Group Captain in charge of Operations (Air) Coastal Command.

He was commissioned as a pilot in No. 612 (County of Aberdeen) Squadron, A.A.F., in 1937, and spent much of the War in anti-submarine activities with Coastal Command. He left the Service after the War, but rejoined with a permanent commission in 1947, since when he has been S.A.S.O. at Air Headquarters, Ceylon, and Aide-de-Camp to the Governor-General, and in 1952 took command of the Coastal Command station at Kinloss.

R.A.F. Appointments

THE FOLLOWING are among recent appointments:—

Wing Commanders: H. E. Barker, O.B.E., to A.A.F.N.E. for staff duties; A. B. Bishop to Air Ministry for duty in the Department of the Air Member for Supply and Organization; D. W. J. Brown to Headquarters, M.E.A.F., for administrative staff duties; J. H. Cocks to Air Ministry for duty in the Department of the Air Member for Supply and Organization; T. P. Gibson, D.F.C., to Headquarters, Fighter Command, for administrative staff duties; N. A. Gwyther, O.B.E., to Headquarters, 2nd T.A.F., for technical staff duties; G. V. W. Kettlewell to R.A.F. Watton for administrative duties; H. W. Lamond to Headquarters, No. 90 Group, for administrative staff duties.

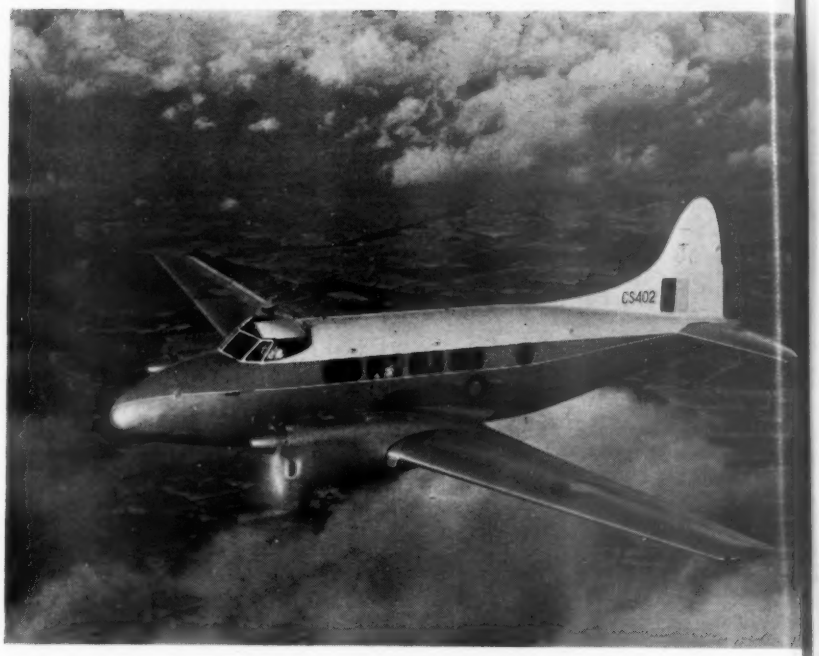
Reunion

Headquarters, Bomber Command.—The Association of Officers 13th reunion will be held at Headquarters, Bomber Command, R.A.F. High Wycombe, Bucks, on May 17. Any members who have not received details can obtain them by applying to the Honorary Secretary of the Association at the above address.

AT CRANWELL.—The passing-out parade of No. 72 Entry took place at R.A.F. Cranwell on April 1, when the reviewing officer was Air Chief Marshal Sir George H. Mills, K.C.B., D.F.C., Commander, A.A.F.C.E. In this picture, left to right, are Snr. Under Off. C. C. Lane (Sword of Honour); Snr. Flt. Cdt. P. R. Adamson (Queen's Medal, Abdy Gerrard Fellowes Memorial Prize and R.N.Z.A.F. Trophy and Air Ministry Prize for Commonwealth and War Studies); Under Off. Sulaiman Bin Sujak (Philip Sassoon Memorial Prize); Snr. Flt. Cdt. R. L. Thomas (R.M. Groves Memorial Prize, Kinkead Trophy, Dickson Trophy and Michael Hill Memorial Prize); Under Off. J. G. McCluney (Hicks Memorial Trophy and J. A. Chance Memorial Prize); Under Off. R. B. Gilvary (R.U.S.I. Award); Snr. Flt. Cdt. J. F. Forshaw (Air Ministry Prize for Secretarial Studies) and Under Off. D. G. G. Waterman ("L'Ecole de l'Air" Trophy for French Studies). At the top of the page are the 16 D.H. Vampires in the fly-past.

Photographs copyright "The Aeroplane"

Ceylon Builds up its Air Force



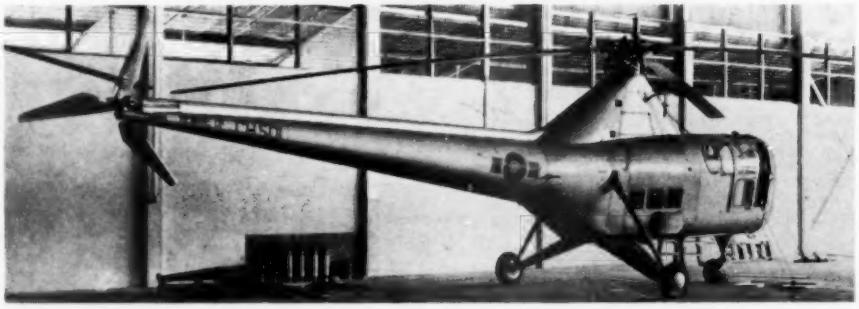
WITH the recent order for six Hunting Jet Provosts, the Royal Ceylon Air Force advances a further step in its expansion, and will be better equipped to meet its primary tasks of flying and operational training for light transport and inter-Service Co-operation duties. In addition to providing economical jet experience the Jet Provosts, on their arrival later this year, will provide a useful operational potential for the maintenance of internal security in Ceylon, being equipped to carry a variety of light armament and other extra equipment.

The R.Cy.A.F. was to have operated British jet aircraft as long ago as 1955, when several D.H. Vampire Trainers were shipped to Colombo, but the Ceylon Government reversed its decision to order these machines, and they were sent back to the U.K. in their original crates.

Although Ceylon is now an independent country within the Commonwealth it still relies on British advice for defence matters, and the R.Cy.A.F. is organized entirely on Royal Air Force lines. It is commanded by Air Cdre. G. C. Bladon, O.B.E., R.A.F., who as a Group Captain and Air Adviser to the Ceylon Government in 1951 was responsible for its initial establishment. He is assisted by several R.A.F. officers and senior N.C.O.s, who at present occupy key positions in the R.Cy.A.F., but flying instruction is now being given by qualified Ceylon personnel and they command the training and operational squadrons.

The R.Cy.A.F. came into official existence on October 1, 1951, when flying training began on de Havilland Chipmunks, and five Ceylon students were sent to Cranwell to complete the R.A.F. College flying course. Personnel were recruited either directly, or from ex-R.A.F. Ceylon nationals, and under British supervision the nucleus of the R.Cy.A.F. was established. The embryo service was set up at the former R.A.F. airfield of Negombo, and a great deal of assistance was obtained from the R.A.F. there in the early stages of organization. A ground training establishment, commanded by an R.A.F. Regiment officer, was also founded at Diyatelawa, for basic recruit training. Aircrew cadets also complete a course there before beginning their flying training.

Top, from de Havilland comes this photograph of an R.Cy.A.F. Dove, which is one of several used for illegal-immigrant patrols and internal security duties. These are shared (left) with Prestwick Pioneers, the short landing characteristics of which are particularly valuable.



The R.Cy.A.F. also has three Westland-Sikorsky S.51 Dragonfly helicopters (left), one of which is seen hangared at Katunayake.

Photographs copyright "The Aeroplane"

For the technical trades, R.Cy.A.F. personnel have been sent to the R.A.F. schools at Halton and Locking, where they have completed a variety of courses, while some of the first Ceylonese pilots to be trained were sent to the Central Flying School at Little Rissington to become instructors. The R.Cy.A.F. Training Squadron at Negombo also received some Boulton Paul Balliols for advanced instruction, and the "wings" course follows the standard R.A.F. pattern, after adjustment for the Chipmunk Balliol sequence. There are now three Ceylonese Qualified Flying Instructors in the Training Squadron, who trained at the C.F.S., and they undergo periodic checks from the R.A.F. Examining Wing.

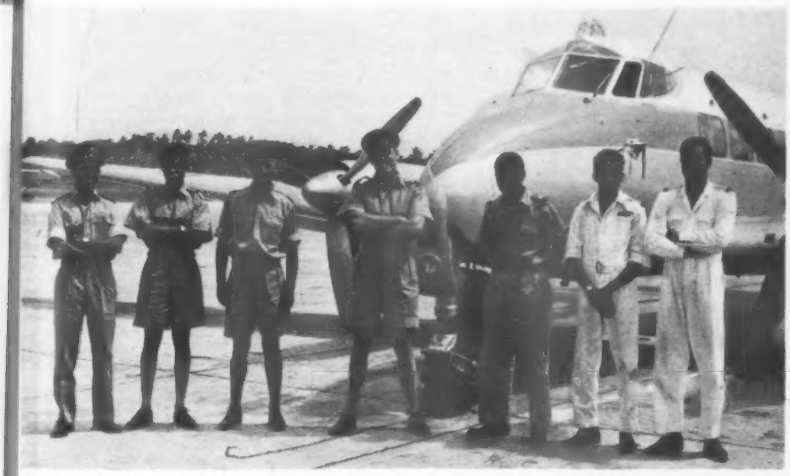
One or two Airspeed Oxfords are also used for twin conversion for the main "operational" aircraft of the R.Cy.A.F., which are de Havilland Doves. These light transports are used mainly for internal communications and for extensive patrols to the north-west of Ceylon, to intercept illicit immigrants from the Indian mainland. They are considered very suitable for these tasks and proved extremely useful in the Ceylon flood emergency at the beginning of this year. The R.Cy.A.F. made its largest effort to date and did extremely well in appalling weather conditions on supply dropping and rescue work.

Frequently operating in very heavy rain, with little visibility and 100-200-ft. cloud base, about 15 Ceylonese pilots, assisted by R.A.F., Indian and U.S. Navy personnel, aircraft and helicopters, dropped 134,000 lb. of food from their Doves, and flew 5-6 hrs. per day during the emergency. For this operation, the doors were removed from the Doves, each of which carried about 1,200 lb. of food, blankets or medical supplies. The R.Cy.A.F. also flew flood reconnaissance sorties and undertook rescue operations with its three Westland-Sikorsky Dragonfly helicopters.

With many disused airfields and strips dispersed throughout Ceylon, the R.Cy.A.F. has a requirement for short-landing aircraft, in addition to helicopters, and Scottish Aviation Pioneers have proved extremely useful since several arrived from the U.K. They fly alongside the Doves in the Operational Squadron on similar duties connected with internal security.

On November 1, 1957, the R.Cy.A.F. took over command of the Negombo airfield, which then became known as Katunayake, and continued to use it as the principal operating base. The entire R.A.F. element was withdrawn, except for a small staging post unit, Britain retaining transit rights for a further five years. A new R.A.F. airfield is being built at Gan, in the Maldives, to maintain the Transport Command trunk route to the Far East, but until its completion Katunayake will continue to be used.

The transfer of this airfield did not affect the R.A.F. element seconded to the R.Cy.A.F., and the British C.-in-C., two Staff Officers, the station commander, the O.C. Flying, and several instructors will remain for as long as requested by the Ceylonese. Although the overall strength of the R.Cy.A.F. is only several hundred personnel and relatively few aircraft, it is well-trained and equipped for its tasks, and the introduction of Jet Provosts should result in a useful increase to its potential.—J.E.F.



Above, seen with Sqn. Ldr. C. J. G. Short (third from left) and Wg. Cdr. A. Mc. K. S. Steedman, D.F.C., (centre) of the R.A.F., are several flying members of the R.Cy.A.F. at Katunayake. Right, R.Cy.A.F. personnel service a Balliol, which is used for advanced training. Below, twin conversion is undertaken at Katunayake on the Airspeed Oxford.

Accuracy and Astronautics

GUIDANCE and control problems associated with long-range missiles were discussed by Professor G. A. Whitfield, B.Sc., F.Inst.P., A.M.I.E.E., A.F.R.Ae.S., of the College of Aeronautics, at a meeting of the British Interplanetary Society on March 1. He said that the control of a long-range rocket ceased at the moment that propulsion ceased, at engine shut-off, and that a missile followed an uncontrolled path thereafter under the influence of gravity and of air resistance near the Earth. It could be said to be "aimed" at the moment of engine shut-off. The computer in the missile could adjust the course (in azimuth and elevation) and the time of shut-off of the engine for the right velocity to reach the target if it were given continuous information of its position.

The position and velocity must be known with great accuracy. To achieve a miss distance of two miles at a range of 2,000 miles, Professor Whitfield showed that the speed must be accurate to within 4.5 m.p.h., and this on a total speed of some 15,000 m.p.h. Velocity and position could be measured by using radar and Doppler from the ground in combination, information being signalled to the missile; or by instruments in the missile.

For the latter system, known as inertial navigation, the missile carried a platform which was stabilized in space to its original vertical and directional angles by gyros. Three accelerometers were mounted on the platform which measured the accelerations on the three axes at right angles to each other; these measurements could be automatically integrated and combined to give velocity. They could be integrated twice to give the distance and direction from take-off and hence the position.

Such accelerometers must have a zero error of 0.03 ft./sec.^{2} compared with a reading during propulsion of, say, 300 ft./sec.^{2}, and the integrators must have a similar accuracy. The final measurement of the velocity must be accurate to about one part in three thousand.

This accuracy in missiles was then compared with the accuracy needed to guide a satellite into its orbit. At the time of shut-off it was necessary to match the velocity, position, and time. Of these, the azimuth direction of the orbit, the position, and the time perhaps did not need to be very accurate, so that only the speed and the angular-elevation components of the velocity and the height must be accurately matched.

Professor Whitfield showed that if the intention were to put the satellite into a circular orbit at a height of 200 miles, and if this were done with the accuracy assumed above for a missile, the satellite would rise only two miles above the circular path to an apogee of 202 miles, with the perigee at a height of 198 miles.—KENTIGERN.

NACA Looks Upward

A SPACE TECHNOLOGY COMMITTEE, newly set up by the National Advisory Committee for Aeronautics in the United States, held its first meeting in February. James H. Doolittle and Dr. Hugh L. Dryden, respectively chairman and director of NACA attended, with the full 15-man membership of the new committee headed by Dr. H. Guyford Stever.

Working groups have now been set up, with their chairmen. Dr. J. A. Van Allen is in charge of "objectives," Dr. Wernher von Braun of "vehicles," and other groups deal with "re-entry," "range, launch and tracking," "instrumentation, communication and navigation," "space surveillance," and last in sequence but not in importance, "human factors and training."—A.E.S.

Cost of a Satellite

CONTROVERSY between the backers of the U.S. Army's Jupiter-C rocket, which launched the first American satellite, and the Navy's Vanguard, which was intended to do so, has broken out on the question of comparative cost. Mr. Garrison Norton, assistant Navy secretary for air, has said that using Jupiter-C for launching was "very, very expensive and rather inefficient when compared with the Navy's Vanguard launching vehicle."

Now Norman L. Baker has come to the defence of the Army in *Rockets and Missiles*. The appropriation for the Vanguard programme was $110 million for launching 13 vehicles and putting up a total of 136 lb. of instrumented satellites; the cost works out at about $800,000 per lb. of satellite, or $160,000 per lb. if the third-stage rocket, which also goes into the orbit, is included. As to the 12 Jupiter-Cs, Mr. Baker ignores the first three, which were used for re-entry tests, and works out that the first satellite, Explorer I, alone cost $390,000 per lb., but that if the remaining eight Jupiter-Cs are used to launch similar satellites, the cost per lb. is reduced to $130,000. And, since Dr. W. von Braun claims that a much larger satellite could be put into an orbit by the Jupiter-C, Mr. Baker's final figure for launching satellites is $65,000 per lb. for the Army as against $160,000 per lb. for the Navy.—A.E.S.

Overproduction in the East

A SOMEWHAT embarrassing situation has arisen regarding aircraft production in Japan, from which it appears that that country now has more aircraft than pilots, crew-members and technicians. The reason for this, as given by a U.S. Navy spokesman in Congress recently, is that the Japanese produce aircraft too quickly.

Under the original cost-sharing agreement with the U.S.A. the Japanese were to operate production lines to increase the production potential and so relieve the U.S. of the burden of providing Japan with some of the aircraft. Congress was told by the U.S. Regional Director for the Far East that to stop the production lines would mean that all economy benefits would be lost.

But suggestions that the aircraft should be sent to the U.S. or to other countries which needed them was rejected. It was explained that the Japanese would need them some time.

Gordon Percy Olley

THIS tribute to the pioneer air-charter operator who died on March 18 (THE AEROPLANE, March 28) has been written by Keith Grand, general manager, Western Region, British Railways, and a former chairman of Olley Air Service:—

The gay companion, gallant warrior, incomparable pilot has set his last course, and those who knew him well will know that the heavens are waiting to welcome him on his last landing.

My friendship with Gordon started when in April, 1933, we (the old G.W.R.) started the first internal airline service in England from Cardiff to Plymouth. We chartered an aeroplane from Imperial Airways—a Westland Wessex—and on the great day when this service was to start I met Gordon Olley—the senior pilot of Imperials whom they had lent to us—at Cardiff Airport.

We, on the railway, were sadly lacking in any knowledge of the air or air transport, but we had determined to make the venture a success. We need not have worried—Gordon really took control! His enthusiasm was infectious—he could see into the future of this gamble—as in those days indeed it was.

The Westland (painted in our railway colours of chocolate and cream) plied backwards and forwards over that route all that summer, and in the following year the route was extended to Birmingham. All this time Gordon Olley was our inspiration. Then in 1934 he started his own charter company backed by the late Sir Hugo Cunliffe-Owen and Sir James Dunn, and by the outbreak of war in 1939 this had reached a high level of success.

In September, 1939, Olley Air Service became a part of National Air Communications—an association of all internal airlines which was formed to carry out work of a communication nature to and from war areas. Subsequently the whole of the activities were transferred to the Associated Airways Joint Committee and Gordon Olley became operations manager with headquarters in Liverpool.

His record was unique—13,500 flying hours as a pilot covering the World—thirteen enemy aircraft shot down in World War 1—and a Military Medal.

He flew me to many Continental capitals, all over England, to Ireland and the Channel Islands, in fair and foul weather, and always he had the uncanny knack of making a happy landing—"happy" because of the tremendous confidence his skill inspired in all his passengers.

Typical of Gordon—at his request his ashes will be scattered over Croydon Airport by an aircraft of Olley Air Service.

So many will miss him.

The International Friendship

IN DESIGNING and developing the F.27 Friendship, N.V. Koninklijke Nederlandse Vliegtuigenfabriek Fokker has re-established its place as a major manufacturer of commercial aeroplanes for use the World over, a position which the company held and for which it was much respected in pre-War years.

The Friendship is now in full production in Holland and at the Hagerstown, Maryland, plant of the Fairchild Aircraft Division. It is on order by a number of airlines throughout the World and has an assured future for many years to come. Just how Fokkers have made such a successful come-back in the highly competitive field of commercial aircraft is an interesting story and the Friendship is no less interesting an aeroplane.

Historical Background

Lest anyone be surprised by the apparently unexpected achievement of such a small aircraft industry as that of Holland in producing so sophisticated an aeroplane as the Friendship with virtually no domestic market to back it, the history of Fokkers must be briefly recalled.

Since foundation in 1919, Fokkers developed a long line of single- and multi-engined civil transports, in parallel with a variety of military types. In the late 1930s, the company concentrated on such aircraft as the D.XXI fighter, G.1 twin-boom general-purpose type, the T.5 bomber and the T.8-W floatplane.

Around 1935, European rights were acquired for manufacturing and selling the Douglas DC-2 and DC-3. Very much on the other hand, Fokker aeroplanes were in service with 54 civil operators and 28 countries had Fokker military types. Licence agreements for production of 34 Fokker aeroplane types were held by 22 countries.

All this came to an end with the invasion of the Low Countries in 1940. During the occupation, some work was done on various German aircraft such as the Arado 196 seaplane, but production results were understandably and commendably below schedule. Despite damage to the factory and looting of machine tools, the Fokker design team was kept together and traditional continuity was preserved. Before the War had ended, the main Amsterdam factory was almost obliterated by bombing and so a completely new start was required in 1945.

A government board was set up to plan and provide for aircraft development in Holland—the Nederlands Institut voor Vliegtuigontwikkeling. The objects of this board were to study new projects, to advise the Government on the best lines for future development, to give orders for prototype construction and to finance it, and to supervise development.

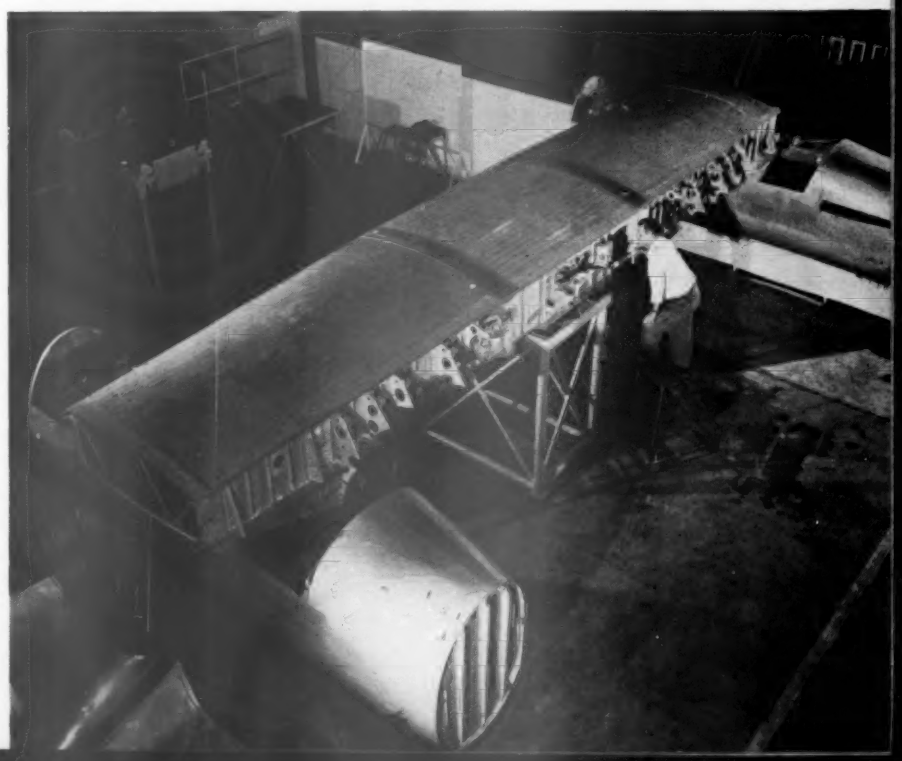
A programme of trainer aircraft was embarked upon in immediate post-War years and the S.11 Instructor two-seat basic trainer, the S.12 nosewheel undercarriage version of the Instructor, the S.13 twin-engined crew-trainer and S.14 Mach Trainer were built—in that order. Another venture was the F.25 Promoter, a four-seat twin-boom pusher private aeroplane of which 20 were built. The S.11 is used by the Dutch, Brazilian and Italian air forces. It is built under licence by Macchi in Italy and in Brazil by Fokker Industria Aeronautica, which is also producing the S.12 and S.14.

Towards the end of 1950 it became clear to the Fokker design team that there would arise a future need for a transport aeroplane of moderate size which would gradually replace the ubiquitous Douglas DC-3. In order to determine more precisely the type of aeroplane to be built, a market analysis was made of World sales potentialities for a passenger aeroplane of medium size to be built in Holland and used for continental traffic—at that time the sales possibilities in America had not been considered.

It is interesting to note in this context that the president of Piedmont Airlines of New York gave an S.A.E. paper in 1951 entitled "Wanted—A New Airplane!" Piedmont now has 12 Friendships on order from Fairchild with an option for 12 more —which would seem to be a clear indication of a need having been met.

This is in rather amusing contrast to the reasons given in the Fokker analysis for limiting the market investigation to exclude

(*Continued on page* 512)

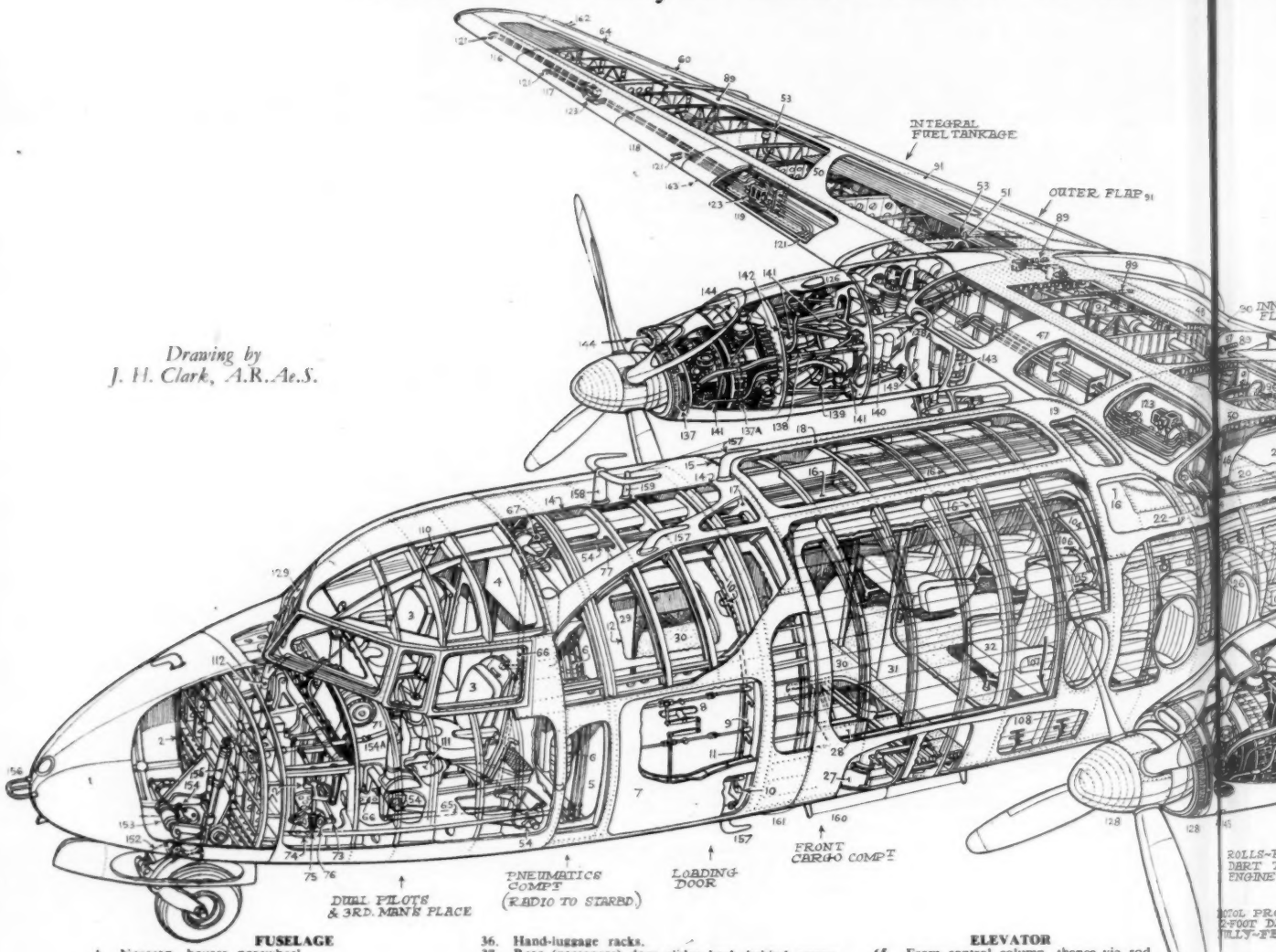


AMERICAN ASPECT.—The Aircraft Division of the Fairchild Engine and Airplane Corp. is making the F.27 under licence from Fokker. This is a wing centre-section, complete with nacelle shells built at Hagerstown, Maryland.

FOKKER F.27 FRIENDSHIP

Two Rolls-Royce Dart R.Da.6 or R.Da. Tu

Drawing by
J. H. Clark, A.R.Ae.S.



FUSELAGE

1. Nosecap, houses nosewheel.
2. Pressure bulkhead.
3. Two pilots.
4. Spares case.
5. Pneumatics compartment (access from cargo compartment) with bottles at 6, and valves.
7. Crew's entry and cargo door (near the ground for low-loading). To open, turn handle (8) to disengage spigots, as (9); pull door inwards so that its rollers (10) move back into vertical slot (11), then push door up into its out-of-the-way retracted position (12).
13. Not used.
14. Pressurizing extends right up to top surface (14) until frame at (15) then steps down to surface (16). (Controls will pass out through pressure-wall (17).)
18. Detachable inspection-cover to unpressurized section.
19. End of unpressurized section (merging into centre-section leading edge).
20. Pressurized fuselage running aft to rear pressure-bulkhead (21).
21 23. Cutaways (22) and (23) reveal front and rear main frames for wing pick-up. (Double frames with light-alloy pick-up members.)
24. Front (expansion-link) wing pick-up.
25. Rear (fixed) pick-up.
26. Line of stringers (which are assembled with the skinning and Redux bonded to it).
27. Underfloor structure (with non-circular underbelly profile) including two longitudinal crash-members (28).
29. Radio box.
30. Cargo compartment.
31. Movable (cellular) partition.
32. Passenger cabin (up to 40 seats).
33. Wardrobe.
34. Pantry and steward's seat.
35. Lavatory.
36. Hand-luggage racks.
37. Rear (passenger) door slides back behind screen (38).
39. Vertical member (each side) with diagonal inter-bracing, bolted to tailplane centre-section box (40) (repeated on rear face (41) and carried off frames (42) and (43) and carrying fin front and rear members (44) 45)).

WING

46. Two-spar torsion box with light' leading- and trailing-edge sections (47) (48), and fairing-piece (48A) attached.
49. Booms are actually bonded laminæ.
50. Stressed-skin with corrugation (riveted along centre section. Mainly bonded in outer wings).
51. Integral light-alloy forging (closed-frame end-rib to centre section).
52. Interconnecting links (centre-section to outer wing) (bolt passes through strap-plate 52A as well).
53. Limits of outer-wing integral fuel tankage.

CONTROLS

Aileron

54. From control column, thence via cables (54), up pneumatics compartment wall, along roof, through wing box, along back face of rear spar to auto-pilot (55) and by return-cable back to control column.
56. Cables from autopilot to aileron linkage (port and starboard) pull (57) to move aileron (62) through torsion-bar (58) anchored at (59); and to move spring-tab (60) which will move aileron aerodynamically. If aileron loading is too great, then movement of (57) will ultimately drive aileron direct through pin (61) fixed to aileron (62) (SEMI-DIAGRAMMATIC).
60. Spring tab.
63. Gear tab and its linkage from fixed point (64) (port wing).
64. Combined auto-plus-hand trim tab (on starboard wing only).

ELEVATOR

65. From control column, thence via rod (65) (with adjustable stops (66)), rod (66) up back face of cockpit wall, cable (67) through roof and dorsal fillet, cable-tension regulator (68) with return-cable to cockpit. Two rods off (68) to elevator shafts (69).
70. Elevator auto-pilot servo unit linked-up to compensator pulley (68).
71. Hand-trim tab (and L.H. control on cockpit console).

RUDDER

72. Pedals with toe-brakes thence via rods (73) to cables at (74). (Rotate worm (75) to raise or lower rods (73) through quadrant (76) for foot adjustment.)
77. Cable up back of cockpit wall, along roof to tail compensator pulley (78); return-cable to cockpit.
79. Rod to rudder post.
80. Auto-pilot servo unit linked-up to pulley (78).
81. Auto tab.
82. Hand trim tab (and R.H. control on console).

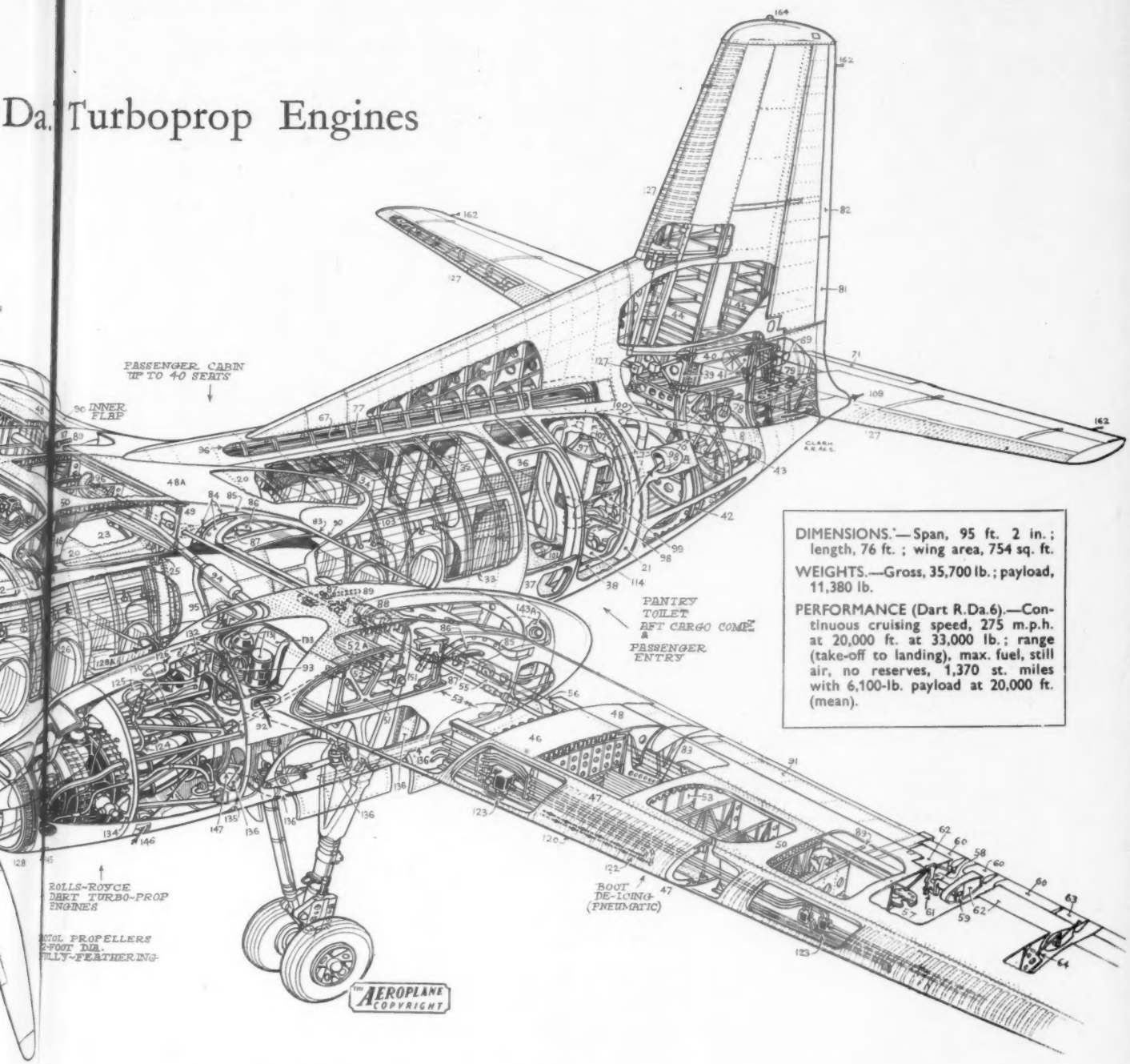
FLAPS

83. Flap and wing-mounting.
84. Flap nose-extension carries two rollers running in guide-trough (85) (to give flap motion).
86. Through slot (86) a driving-spigot (87) connects to flap-tip (shown cut away) to drive flap.
88. Flap driving-gear is on back face of rear spar and comprises driving-motor and gearbox (88), two power take-offs to screw jacks (89) with driving-stubs (87). Power-gearbox (88) drives a series of screw-jacks (89) (one at each end of each inner flap (90) and outer flap (91)).

PRESSURIZING SYSTEM

92. Air in at (92) to blower (93) (driven off auxiliaries gearbox) then via silencer (94) with underwing spill (95), trunk (96), primary heat exchanger (97) with its cooling-air entry (98A) and out at star-

Da. Turboprop Engines



DIMENSIONS.—Span, 95 ft. 2 in.; length, 76 ft.; wing area, 754 sq. ft.

WEIGHTS.—Gross, 35,700 lb.; payload, 11,380 lb.

PERFORMANCE (Dart R.Da.6).—Continuous cruising speed, 275 m.p.h. at 20,000 ft. at 33,000 lb.; range (take-off to landing), max. fuel, still air, no reserves, 1,370 st. miles with 6,100-lb. payload at 20,000 ft. (mean).

board. Main air from (97) on via turbo-expander (98), secondary cooler (99) (with its cooling-air in on starboard and out to port). Main air up through water separator (100), through bulkhead (21) into cabin underfloor (102). Tapping off cold (cooling) air (100) may be mixed at (C) with hot air via (X).

101. Underfloor air-trunk (101) (with a silencer) then on to wall-duct (103) embodied in plastic luggage rack (104) with individual louvres (105) and an all-along leak-out (106).
107. Cabin air out into underfloor via kicking strip (108), thence to atmosphere via tail exit (109).
110. Extension of starboard luggage-rack trunk (103) into cockpit, with underfloor electric heater (111), two foot-heaters, and windscreen de-mist trunk (112).
113. Not used.
When blower air (92) is not working, use cooling-air (98A) for cabin supply. A connection from starboard side to trunk 101 but aft of bulkhead (21) gives ground connection.
114. Small box in corner of compartment, contains outflow safety-valve, plus pneumatic relays, dump control valves (and vents to atmosphere under).
115. Not used.

DE-ICING SYSTEM
(Leading-edge inflatable boots)

116. Leading edge boot divided into sections, as (116) (117) (118) (119), each section comprising a number of narrow cells side by side, as (120) and each section fed by two pulsating feed lines as (121).
121. Each of the two lines (121) is connected to alternate boot-cells, as (122), in its section and pulsation is governed by the electronically controlled valves (123).
124. High-pressure feed from (each) engine second-stage compressor, thence via lines (125) to units (123).
126. Engine breather outlet.
127. Extension to tail for fin and tailplane.
128. Electric anti-icing for engine, spinners, cowl and propellers.
128A. Cooling-air ducts in wing for accessories.
129. Built-in electric anti-icing to windscreen.

ENGINES AND NACELLES

130. Power take-off to auxiliaries gearbox driving generator and alternator (131), blower (93) and pneumatic system air compressor (132) generators cooling-air in at (128), out at (133).
134. Engine front firewall.
135. Rear firewall and pickup from nacelle.
136. Other principal nacelle diaphragms with stressed skin, front struts and nacelle longerons.
128-134. Zone I.
134-135. Zone II. (Beyond is Zone III including jet pipe cooling.)
137. Front fire spray ring; additional spray at 137A.
138. Spray ring around inside the cans.
139. Rear spray ring.
140. Two bottles.
141. Firewire cage and detector switch (142).
143. Fuel collector tank.
143A. Water-methanol tank.
144. Oil cooler air in and out.
145. Zone I cooling air in.
146. Zone II cooling-air into jet-pipe shroud.
147. Line of jet pipe.

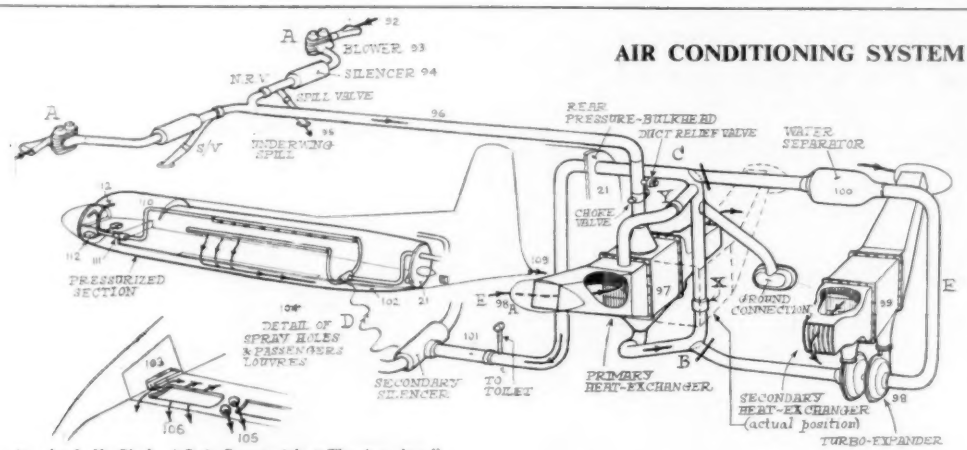
UNDERCARRIAGE

148. Radius-rod off front spar via diaphragm and member (149).
150. Operating jack off front spar.
151. Main leg off rear spar.
152. Nosewheel shock absorber.
153. Steering jack working vertical spindle via link (154) and cockpit control (154A).
155. Retracting operating jack.

RADIO

156. Glide-slope receiver.
157. VHF communication antenna.
158. VHF navigation antenna.
159. HF aerial.
160. ADF sense aerial.
161. Marker beacon, ADF loops all under fuselage.
162. Static discharger.
163. Landing light.
164. Anti-collision light.

AIR CONDITIONING SYSTEM



Drawings by J. H. Clark, A.R.Ae.S. copyright "The Aeroplane."

Standard circuit is A, B, C, D; when required, B, E, C is an additional circuit. When bypass X is partly opened, warm air is supplied to the cabin with cold air from the turbo-expander. When the blower is not working, ram air E is used in the system via bypass X.
Numbers used above are in key on pages 510 and 511.

(Continued from page 509)

the United States and Canada because "there seems to be little chance to sell European aircraft." This, of course, was two years before the first sale of Vickers Viscounts to Trans-Canada Air Lines in November, 1952.

The analysis of traffic as to intensity, trip length and aeroplane size showed clearly the tremendous gap which would be left if the Douglas DC-3 were to be taken out of regular airline service. A number of operators supplied data on their ideas for a modern successor to the DC-3, the numbers required for replacement and for expansion of services.

Investigation of the market was limited to inter-continental traffic for which—in Europe, at least—a twin-engined aeroplane was preferred for reasons of simplicity. Fokkers contend, quite rightly, that only the preference for special engines, or the lack of sufficiently powerful (and, one might add, reliable) powerplants, has led to the use of multi-engined aircraft for inter-continental use.

The survey showed that there were no medium-sized aeroplanes in production or under development which were sufficiently up to date to be able to participate economically in the future regular World traffic. At mid-1950 over 60% of the total amount of traffic with this type of aeroplane was still carried by the DC-3 and there was a pronounced peak in traffic for stage lengths in the region of 250 miles. This last conclusion was of great importance with respect to the choice of maximum payload-range performance for a DC-3 replacement.

Another significant fact established in 1950 was that there were no aircraft in the 10- to 15-ton weight class then under development. This indicated that any new aeroplane of this size would not meet much competition.

As a result of all the investigations made, it was concluded that there was a definite need for a modern replacement of the DC-3 with a capacity of 32 passengers and a range of about 300 miles with maximum payload. The new aircraft would have to fly faster, be pressurized, have a nosewheel-type undercarriage and be at least as cheap to operate as a DC-3. Fokkers answer to these requirements was the F.27.

Under the auspices of the government board mentioned earlier, 27 million guilders (about £200,000) were invested in the first four Friendship prototypes. This money was to be repaid as sales were made and costs were recovered.

In 1951 a large factory was built at Schiphol Airport to replace gradually the original works in Amsterdam North. Fokkers took on the repair and overhaul of DC-3s and several types of military aircraft, the production of Gloster Meteors and Hawker Hunters, and collaborated with other Netherlands factories in producing a small number of Saab 90 Scandia transports. Thus the shops were kept full of aeroplanes, whether or not they were of Fokker design. Hunters are still being produced and they will progressively be replaced by Friendships which are due to reach a production rate of six a month by September, 1959.

Additional production space was obtained in 1954 when Fokkers took over the former De Schelde factory at Dordrecht, where a large batch of the Saab 91 Safir was made under licence from the Swedish parent company. This factory is now used for the production of both Hunter and Friendship parts, but will eventually make only components for the latter. Dordrecht is at present producing mainplanes, front fuselages and engine nacelles for the Friendship. The Redux-bonded stringer-skin wing panels are transported from Schiphol to Dordrecht for assembly, the completed wings being taken back to the main factory for final assembly.

Total personnel at Fokkers is in the region of 5,000 of whom about 3,200 are at Schiphol. More people have recently been taken on at Dordrecht to cope with the expanding Friendship programme.

Work on jigs and small parts is done at the former Avio-Diepen Industrie Mij. N.V. factory at Ypenburg which was also acquired in 1954. More production space recently became available when a new design office building was completed at Schiphol. This houses all technical staff.

Aerodynamic Design

No one can have been greatly surprised when the F.27 project was announced as a high-wing design, in view of the long line of Fokker ancestors with like layout—whether with one, two, three or four engines. The choice for the Friendship was not made on traditional grounds, however, although many of the reasons for the pre-War layout are still valid.

A high wing is favoured largely because of easy and rapid ground handling so necessary for the high utilization required of short-range aircraft. The market survey showed that many operators were in favour of a high wing for that reason alone.

Other decisive advantages are the better aerodynamic properties of the high-wing/fuselage combination and the possibility of using 12-ft. diameter propellers which give better take-off and climb performance, yet have ample ground-clearance.

Incidental advantages, which are none the less important from the passenger's viewpoint, are the absence of wing glare when flying in sunlight, the excellent downward view from all seats and the useful shade afforded when on the ground in hot weather.

The high wing has both good and bad points so far as safety is concerned. A wheels-up landing is safer for a high-wing aeroplane because rupture of wing fuel tanks, electrical short circuits and associated fire risk are less likely. The Friendship has this risk reduced still further by having integral tanks only in the outer wing panels. The chances of the wing tearing off are less with a high-wing aeroplane and the passenger cabin floor is not imperilled as would be the case with a low-wing type where floor structure is virtually attached to the wing.

On the other hand, a high-wing aeroplane is less well able to absorb the kinetic energy released in a crash-landing. The fuselage has to transmit the inertia forces from wing and engine nacelles to the ground and its underside has to be strong enough to withstand ground reactions.

In the case of the Friendship, the structure has been designed for 10g accelerations fore, aft and downwards. The bottom structure is reinforced with two beams running fore and aft, distributing floor loads to the frames and forming part of a strong torsion box with excellent energy-absorbing characteristics in the event of a belly landing. This does, of course, involve some increase in weight and it became necessary to flatten the fuselage underside slightly, thereby reducing the

(Continued on page 513)

(*Continued from page* 512)

length of the undercarriage. However, it is felt that this slight disadvantage is more than offset by the aerodynamic advantages of the high-wing layout with its uninterrupted upper surface.

In attempting to arrive at the best possible layout for a twin-engined transport aeroplane, the two basic parameters are the maximum lift at take-off and the drag during all single-engined climbs at low speeds. These parameters have a big influence upon the climb performance on one engine, which determines the maximum weight of the aeroplane.

An extensive study was made to investigate the effects of aircraft layout upon these factors. It was started by compiling all available information on wing/fuselage and wing/nacelle combinations with the purpose of showing which basic configurations or which type of detailed refinement might result in the desired aerodynamic properties being attained. This compilation of data was followed up by wind-tunnel testing of several nacelle and fuselage models to extend the knowledge gained. These models were tested with a 21% thick wing model of 24-in. chord at a wing Reynolds number of 3×10^6.

As a result of these investigations for the projected design, a high-wing layout with low-set, long engine nacelles was found to give the best compromise for performance. A low-wing layout with low-set nacelles was precluded because of inadequate tip clearance for the propellers. The final conclusion was that, allowing for the structure design required, a high wing would carry the best payload.

The Friendship wing has an aspect ratio of 12 : 1, span and area being 95 ft. 2 in. and 754 sq. ft. respectively. The root to tip taper-ratio is 2.5 : 1. The centre-section has neither dihedral nor washout, but the outer planes have 2.5° dihedral and 2° geometric washout. The aerofoil sections are NACA 64-421 (modified) at the roots and NACA 64-415 at the tips.

Flap design started with the testing of five two-dimensional models of 24-in. chord. These were of double-slotted type and met the original ICAO performance requirements for take-off, climb and landing. NACA double-slotted flaps were compared in efficiency with Fowler-type area-increasing flaps and a double-slotted type of Fokker design in which camber was increased with deflection.

The NACA double-slotted flaps produced a maximum lift coefficient of about 3.3 compared with 3.7 for the Fowler and Fokker types. Although the simplest mechanically, the NACA flaps proved to be too sensitive to precise location of the attachment points for reliable take-off performance. The Fowler flaps gave very high lift on landing, but it was difficult to position the guide-rails without losing lift.

The Fokker double-slotted design gave good "reproducable" take-off performance, the lift not being spoiled by "dirty" attachment brackets. For take-off these flaps were lowered to 15° (a deflection of up to 25° was tested) and used as a single-slotted type without change of flap camber. At landing, the flap was lowered to 40° with the rear portion aft of the second slot lowered a further 40° relative to the front portion.

Flight development showed that in single-slotted configuration the first prototype Friendship's flaps were more efficient than had been estimated, and the gap of the second slot was closed. In production, single-slotted flaps are used with deflections of 15° for take-off and 40° for landing. The flaps extend over about 70% of the span and this, combined with the unbroken wing top surface, gives exceptionally good results.

Flying Controls

As a direct result of the large-span flaps, the ailerons are of small span. Following satisfactory wind-tunnel test results, slotted ailerons were fitted to the prototype but, although effective so far as rate of roll relative to control surface deflection, they proved to require too high a stick-force. Although this cannot be pinned down very definitely, it seems fairly certain that this is a case of scale-effect in that there is probably some form of boundary-layer separation at the higher Reynolds numbers experienced with the full-size aeroplane.

It was thought to be unlikely that a change in tab configuration would give a satisfactory improvement of the erratic control force behaviour and it was decided to design completely new ailerons. After some exploratory wind-tunnel measurements, an unslotted aileron with small elliptical nose and set-back hinge-line, using large maximum deflections, was chosen. Since the reduction of control forces by the nose balance could be but a small one—allowing for the required large maximum deflections of the aileron—a very effective spring-tab system was adopted for further force-reduction. This new type of aileron has proved to be entirely satisfactory in flight.

Static longitudinal stability, stick-fixed, was found to be slightly less than that indicated by wind-tunnel results. With the elevator control first fitted, the estimated centre of gravity range from 25% to 40% of aerodynamic mean chord was obtained when stick-force stability was slightly increased by the addition of a "bungee" device in the elevator control circuit to cope with the lower static stability of the aircraft.

In a successful effort to extend the C.G. range from 20% to 40% chord, it was necessary to provide more "up" elevator movement in order to approach the stall, otherwise the minimum approach speed was the limiting factor. The amount of elevator deflection attainable was increased by the simple expedient of decreasing the nose-balance length within the shroud for a higher total deflection, the shroud being brought back to maintain the same nose gap.

The deflections are now 25° up and 22° down and the C.G. range is from 18% to 41% chord in flight, the range during take-off and landing (i.e., with undercarriage down) being 20% to 38% chord. The original rudder required little alteration as a result of flight trials, although the control forces were not in full accord with wind-tunnel test. The slight heaviness was cured by the addition of a geared-tab which reduced the load.

Structure Design Philosophy

Simplicity and logic of approach to the problems involved is the keynote of the F.27 structure. Externally of very orthodox layout, the Friendship is in some ways unusual "under the skin." Faced with the choice of either buying a complete complement of machine tools capable of producing components of the sizes required—not an easy task in the immediate post-War years—or of adopting a different approach, Fokkers chose the latter.

In 1948, studies were made of the then-new techniques being developed for airframe construction. The most promising of these were taken for evaluation and the chosen method was an approach to integral construction by the use of bonding, stringer-skin panels, laminated skins and spar booms.

The F.27 is not the first Fokker aeroplane to have Redux bonding. Sets of bonded wings were made for the S.12 trainer which had spar booms of bonded laminations. Some 30,000 hours of testing under conditions of aerobatic flight were followed by a static load test without reaching failure point.

Production use of these methods was made in the S.14 Mach Trainer which had tailplane, rudder, fin spars, flaps, elevators, ailerons, dive-brakes and some frames made in this way.

The F.27 has greatly extended use of the bonded technique, the main object being the elimination of rivets as far as possible and the securing of a good fatigue life. The use of a fully stabilized structure—one in which all skin doublers are in intimate contact with the main skin over their entire area, rather than the localized "point" contact of riveted structure—gives much better static strength, saves weight (about 5% of tare weight), has a better fatigue life and has greater resistance to buckling.

Doubler plates can conveniently be used for better distribution of stress at the edges of panels and at local concentrations of loading. The window frames are an example of this. In general, the use of Redux bonding gives a smaller unsupported length on any panel and gives a bigger area of contact for ribs and stringers than that given by mechanical fastenings.

The vast Redux bonding shop at Schiphol is most impressive because of its cleanliness and neatness. A universal tooling system is used for the bonding of stringer-stiffened panels and the curing process takes place in an autoclave. The press method is the alternative, but this is not so convenient when combining stringer-stiffening with laminated skins.

The stringers are covered by extruded-section metal caps, so that the covering blanket presses only upon the stringer flanges and does not flatten the stringers. In other words, the "brim" of the top-hat section stringer takes the pressure without any being placed upon the "crown" of the top hat. A small range of cap sizes caters for the various stringers used.

To avoid wear and tear on the blankets, otherwise due to being constantly pressed down over a series of stringers, the spaces between the stringers are filled with sand or gravel up to the level of the tops of stringers so that a flat aluminium blanket can be used instead of a rubber one.

These simplifications of manufacture are exemplified by the fact that the complete outer wing skin panel, which is about 30 ft. long, has only one tool and two such panels can be cured together in the autoclave in two hours. A similar procedure is used for the inner wing.

Very great care is taken with the Redux bonding process and the treatment of the metal used. Components are loaded on to bars with specimens which are later tested by the laboratory and a complete record card is kept.

The bar-loads are remotely controlled by crane into and out of the various treatment baths prior to bonding—degreasing, rinse, pickle (D.T.D. 915A), chromic sulphuric acid, rinse, anodising by chromic acid (D.T.D. 910C), cold rinse, hot dip—and into the drying ovens. At the end of this treatment the bars are moved off the guide rails by hand and pushed along to the beginning of the bonding process. There the various components are unloaded on to "application tables" where they are picked up by gloved operatives who apply Redux liquid and powder or film, the film being a combination of liquid and powder.

Clean sheets of paper are spread out for each bar-load to

collect the spill of surplus resin as it is applied. Small components stored on racks before curing in the autoclave are covered with polythene curtains, or else assembled right away, to avoid contamination which might affect the efficiency of the bonding process.

Before any assembly is cured in the autoclave, test strips are bonded and peel-tested for every batch of which parts are used in the assembly. The peeling test is used as a very effective check on the pre-treatment of the parts.

The parts ready for curing are laid out on tables and gravel poured on to bring the level up to a uniform height, so that the soft aluminium blanket can be put down. Thermocouples are placed at certain check-points on each component and then a vacuum pump evacuates the volume between blanket and table immediately prior to loading into the autoclave.

Temperature and vacuum in the autoclave are monitored by an operator. There are 44 different bonded panels in the fuselage, all in single curvature. The front fuselage and the tail end are riveted, the latter being outside the pressure hull.

The other interesting major departure from traditional practice is the use of glass-fibre structure on a large scale. Again, this material had been tried out on the S.14—for wing and tail root fairings—prior to its adoption for the F.27. Considerable tooling up time is saved by its use, no machine tools are required for its manipulation, it provides a very efficient structure and it is easy to repair.

The snag with glass-fibre is its low modulus of elasticity, but with the Friendship this is turned to advantage because the material is principally used where a low modulus is desirable for secondary structure. Wing leading and trailing edges, tailplane and fin leading edges are of glass-fibre sheet and metal honeycomb construction. The modulus of elasticity of these portions of the flying surfaces is thereby made about equal to the metal primary structures to which they are attached. This compatibility is not essential, but it is obviously preferable to the skin-wrinkling which normally goes on with metal leading-edge structure under compressive loads.

From the aerodynamic point of view (and the Friendship is a very "aerodynamic" aeroplane in terms of clean lines) a smooth wing leading edge is highly desirable, because it influences airflow over the surface behind. Structurally, there are the additional merits of ease and cheapness of accurate fabrication of intricate shapes, and high impact strength. Glass-fibre is also used for the fuselage nose fairing (whether or not radar is fitted as with some Fairchild-built F.27s), for luggage racks, various air ducts, tail cones of the engine nacelles, the top rear fairings of the nacelles, flap shrouds (integral with wing trailing-edge mouldings) and wing-tip fairings.

Primary structure of the F.27 follows fairly well-established lines for aluminium-alloy airframes, except for the extensive use of Redux bonding already noted. The principal materials used are 75ST6 and 24ST4. Most sheet material is clad to the extent of about 5%, dependent on thickness. Heavy top-hat section stringers are drawn, unclad.

The American 75ST copper-bearing aluminium alloy is used around the wing-to-fuselage joints and for most of the wing skinning, this type of material having better fatigue life characteristics than zinc-bearing alloys. American materials were chosen because they are obtainable from an Alcoa licensee producer in Holland, from Germany and Switzerland. Obviously, the use of American specifications has helped enormously in speeding the F.27 into production in the U.S.A.

All bolt and screw threads are to the Unified Standard and, where possible, U.S. standard parts are used. There is much general use of castings and forgings, all load-carrying fittings being forged in 24ST or 75ST. The control system makes extensive use of magnesium castings.

The fuselage main floor panel is built inverted and is then moved to the fuselage building jig for the addition of frames and bonded stringer-skin panels. The front fuselage is built as a separate unit before being added to the structure; it incorporates a wind-screen of laminated sheet bonded flat and then bent to shape.

There are four forged main pick-up fittings on the fuselage for the wing centre-section, two on each spar frame, connecting with both upper and lower spar booms. Two smaller fittings are positioned nearer to the centre-line. The tops of the spar frames are formed by forged members. The main torsion box is formed by two single-web spars, with T-section laminated, bonded booms and 75ST6 stringer-skin panels at top and bottom surfaces of the wing.

The centre-section primary structure is built in halves, joined on the aircraft centre-line. On the under (tension) side of this joint, there are five laminations bonded on over the mating faces. Two laminations bridge the gap on the upper (compression) surface.

Top surface skins of the centre-section have heavy top-hat section spanwise stringers bonded on. Load is transmitted between centre section and outer wing panels through lugged fittings bolted inside the ends of these stringers through angle-brackets riveted to the "brims" of the stringers. The top skin is in three panels and has bonded stringers. Lower surface skin is also in three panels, but is riveted to the stringers. Panel butt-faces are bridged by riveted double capping strips.

At the mating faces of centre-section and outer panels there are bonded-on local doubler plates to diffuse load from the stringers. When the centre-section structure is completed, forged 75ST ribs are attached at the outboard faces and the engine nacelles are bolted on at their front and rear with riveted side angle members.

Engine nacelles are of light riveted stringer-skin-frame construction, and are very nearly as large as the Hunter fuselages also being built at Dordrecht. Two heavy top-hat section stringers are at the base of the nacelle, framing the main undercarriage-leg cut-out. The wheel-well cut-out is boxed-in by further members. At the rear of the nacelle is the mounting for the Dart water-methanol tank which is retained by straps.

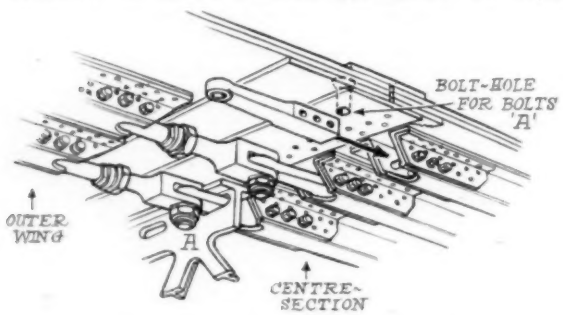
The outer wing torsion boxes use tapered sheet and form integral fuel tanks, and one was tested up to twice the ultimate load without leakage.

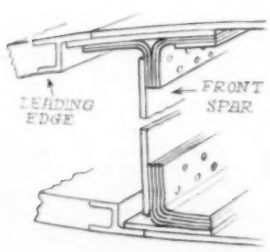
Tests include water-tank pressure testing of the fuselage with and without flexure of the wing; static testing of the whole wing; dynamic testing of the wing outer panels; and many individual fatigue tests on components, particularly wing joints, panels on wing and fuselage, and wing static shear-loading on panels with and without windows.

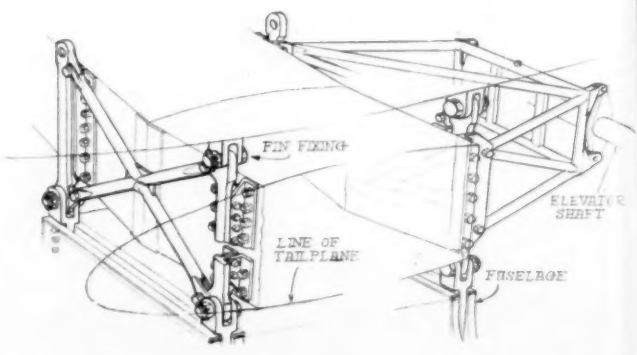
The first, third and fifth Friendships are now flying; the second was structurally tested to destruction; the fourth aircraft is still used for dynamic testing. The fifth Friendship is the first production aeroplane and made its maiden flight on March 23, eight days ahead of schedule. This first-off production aircraft will be submitted to an extensive test programme before delivery to Aer Lingus in October. The second operator to receive a Friendship will be Braathens SAFE, of Norway. The fuselage of this eighth F.27 was lifted out of the assembly jig last month.

The Fairchild Friendship

As built by Fairchild in the United States, the F.27 will differ very little from the Dutch original. Redux bonding is to be used for primary structure, but the glass-fibre leading-edge sheet for wings and tail surfaces is to be replaced by all light







STRUCTURAL DETAILS.—Left, wing front spar with laminated booms. Above, wing joint of centre-section and outer wing. Right, tailplane and fin fixing.

Drawings by J. H. Clark, A.R.Ae.S.
Copyright "The Aeroplane."

alloy honeycomb. The reason for this is two-fold—glass-fibre is as yet a rather costly structural material in America because of the high cost of the labour required; and it is thought that the replacement of de-icing boots may be cheaper with metal leading edges.

Externally, American Friendships will be longer because provision is made for the installation of Bendix RDR-1D weather-mapping system in an extended glass-fibre nose fairing. Whereas the standard Friendship has eight cabin windows, and those for Aer Lingus will have nine, the 40-seaters for some American customers will have ten windows.

Internally, there are various alterations in equipment specified. The pneumatic controls are retained, although with some American components. Ground cabin-conditioning will be of the Stratos Model BUR75-1 vapour-cycle screw-compressor type taking peak loads from the normal Kollsman KSG4 air-cycle cabin pressure control system. Janitrol combustion heaters will also be available. The Roots-type cabin blowers, made by Sir George Godfrey and Partners, will be retained.

Radio equipment for Dutch F.27s is already mainly American. Although Goodyear tri-metallic disc brakes with cast wheels will be specified for Fairchild F.27s, the Dunlop Maxaret anti-skid system of Fokker Friendships is to be retained and will be made under licence by Westinghouse.

The 1,800 s.h.p. Rolls-Royce Dart R.Da.7 Mk. 528 engine, available as an alternative to the 1,600 s.h.p. R.Da.6 Mk. 511 turboprop unit, will be fitted first to the Fairchild F.27s supplied to Wien Alaskan Airlines. A full description of the Dart R.Da.7 appeared in THE AEROPLANE for February 28.

The biggest capacity F.27s will be the 44-seaters on order for Quebecair and Northern Consolidated Airlines. Price of the standard version is $590,000 or 2,100,000 guilders. Fairchild have the sales rights for the American zone of influence with the exception of Brazil where Fokkers are already established.

Systems, Services and Controls

Pneumatic systems are not very popular these days, nor have they ever found wide-scale acceptance for basic aircraft services in commercial aeroplanes. Fokkers' choice of pneumatic power for undercarriage actuation, nosewheel steering and operation of wheel brakes is therefore noteworthy.

Apart from safety considerations—elimination of the fire risk present with hydraulic systems—cleanliness and engine-gearbox power commitments, the pneumatic system is also advantageous in providing very fast retraction of the undercarriage which gives rapid reduction in drag at take-off.

Storage pressure of the system is 3,300 p.s.i., with a maximum operating pressure of 1,000 p.s.i. High-pressure rigid lines are of tungum and stainless-steel tubing; lines taking up to a working pressure of 330 p.s.i. are of light-alloy tubing. Aeroquip flexible hoses are used and all lines have AGS-type connections. There are two separate high-pressure supply lines, one in each nacelle. The main storage bottle is in the fuselage.

Electrics consist of 28-volt DC main supply with a secondary 115-volt 400-cycle AC circuit. One DC generator is mounted on the accessory gearbox of each engine. There is a 208-volt AC supply for de-icing of air intakes, propellers and spinners, and for windscreen anti-icing. A 26-volt AC circuit is used for indication of flap position, oil pressure, fuel flow, turn and slip, and AC power failure. Very comprehensive radio and electronic equipment of American manufacture is specified, the manufacturers concerned being Collins, Bendix and Sperry.

Two engine-driven Godfrey compressors of Roots type maintain a maximum cabin pressure differential of 4.16 p.s.i., giving a cabin altitude of 8,000 ft. (2,440 m.) at a height of 20,000 ft. (6,100 m.). Cabin pressure is controlled automatically and any cabin altitude between zero and 8,000 ft. can be selected, providing the maximum differential pressure is not exceeded. There is a standard 8-in.-diameter connection for air conditioning on the ground.

Wing, tailplane and fin leading edges have Goodrich chordwise pneumatic de-icing boots built integrally with the easily detachable leading-edge honeycomb structure. Boot-inflating air is bled from the engine compressors and a vacuum is preserved in the system when not in operation. The individual boot panels are operated by solenoid valves controlled by an electronic cyclic-timer.

The fuel supply is carried in the outer wing panels, the torsion boxes of which form integral tanks with a total capacity of 795 Imp. gal. There is an 11-Imp.-gal. stainless steel collector tank on the inboard side of each engine nacelle. These tanks are connected with the appropriate integral tank by two fuel lines so that there is a minimum of fuel unusable due to aircraft altitude. There is a crossfeed line so that either or both engines can draw fuel from either main tank.

Control circuits are of cable type, with Teleflex cable-tension regulators. All control surface cables are Lockclad, with light-alloy tubes pressed around the free lengths.

Wing flaps are mechanically synchronized and electrically operated, with a manual emergency control. Mechanical gust-locks are provided for all flying control surfaces, operated by a lever behind the pilot's seat. One or other engine throttle is always ganged with the gust-lock lever so that take-off cannot be made with locks engaged, but there is sufficient power for taxi-ing

FUSELAGE FLOOR.—Built inverted, the F.27 fuselage floor is then turned upright (as seen here at Schiphol) and moved to the assembly jig for the addition of frames and bonded panels.

Friendships and the Future

Firm orders for 98 Friendships have been placed so far, a fact which tells its own story of commercial success. Of these, 35 Fokker-built F.27s are for service with seven air lines and for five customers requiring executive aircraft, while the 63 Fairchild F.27s are distributed between 12 air lines and 11 orders for the executive version.

Apart from the various air-line and executive versions of the Friendship, freight and trooping variants have been designed, known respectively as the Freightship and Troopship.

The story of the Friendship would not be complete without a short list of top personnel at Fokkers. Under the three directors—F. J. L. Diepen, Prof. E. van Emden and H. During—Ir. H. C. van Meerten is chief designer and a sub-director. Other notabilities are Ir. W. J. Wolff, works manager; H. V. B. Burgerhout, chief test pilot; A. P. Moll, assistant chief test pilot; Ir. R. J. Schliekelmann, production research manager; Dipl. Ing. C. H. Voûte, experimental department manager; Ir. E. van Beek, chief stressman; Ir. J. H. D. Blom, chief aerodynamicist; and Dr. J. H. Greidanus, chief technician.

These are the men under whose guidance and acumen the Friendship has become an important aeroplane in the field of international air transport and has thereby sent the name of Fokker around the World once more.—D.G.

LIST OF BRITISH SUPPLIERS

Access Equipment, Ltd.; Aero Research, Ltd.; Aircraft Marine Products (Gt. Britain), Ltd.; Bell's Asbestos and Engineering, Ltd.; Brown Brothers (Aircraft), Ltd.; Brunton's (Musselburgh), Ltd.; Delaney Gallay, Ltd.; Dowty Equipment, Ltd.; Dunlop Rubber Co., Ltd. (Aviation Division); English Steel Corporation, Ltd; Expanded Rubber Co., Ltd.; Sir George Godfrey and Partners, Ltd.; Goodyear Tyre and Rubber Co. (Great Britain), Ltd.; Graviner Manufacturing Co., Ltd.; Imperial Chemical Industries, Ltd. (Plastics Division); The Walter Kidde Co., Ltd.; Marston Excelsior, Ltd.; Normalair, Ltd.; Rolls-Royce, Ltd.; Rotax, Ltd.; L. A. Rumbold and Co., Ltd.; Joseph Sankey and Sons, Ltd.; Saunders Valve Co., Ltd.; Smiths Aircraft Instruments, Ltd.; Super Oil Seals and Gaskets, Ltd.; Teddington Aircraft Controls, Ltd.; Teleflex Products, Ltd.; Varley Dry Accumulators, Ltd.; Venner, Ltd.

Local Service Operators Discuss the F-27

Two recent addresses summarized

"*Introduction of New Transport Designs and Their Effect on Traffic Potential for Local Service Airlines*," by William J. Mitchell, vice-president, traffic and sales, Bonanza Air Lines

NEW equipment for the local service airlines, typified by the Fairchild F-27*—first twin-engined turboprop off the line (in the U.S.A.) and first to become operational—is just about everything they need, according to this speaker. The gas turbine is the key to future equipment for these operators, and the end of the period of usefulness of the reciprocating engine is at hand. If this new powerplant were not here, they would be condemned to continue operating with the same slow, costly, obsolete, hand-me-down equipment they had used for so long.

The DC-3 had enabled local airlines to begin operations and had made possible the greatest share of their progress to date; but they could not progress in this Jet Age with equipment designed for air transportation's horse-and-buggy era. The DC-3 has outlived its usefulness. It *was* developed 22 years ago. It *is* slow. It is *not* pressurized. It is, above all, *uneconomical*. Finally, it retards efforts to stimulate new traffic and impedes the proper extension and development of new routes.

With a marked increase in cruising speed, pressurized and air-conditioned comfort, low cabin noise level, lack of vibration, superb passenger visibility, and operating economy, aircraft in the F-27 class will—if properly used and promoted—attract substantially larger volumes of traffic and make it possible for local airlines to serve that traffic more efficiently. Such new equipment, plus the strengthening of route structures, will set American local service airlines firmly on the road toward decreasing dependence on government developmental assistance and an ever-increasing measure of self-sufficiency—with subsidy-free operations the ultimate goal.

The introduction of gas turbine aircraft challenges the ingenuity of the local carriers in planning their proper utilization, and there will be a difficult period of mixed-fleet operations, especially while the fleets are dominated by the slower, less comfortable aircraft with their high operating costs. Of more immediate concern is the problem of financing re-equipment programmes; not only is the cost of modern aircraft six to seven times above that of DC-3s, but the local service operators often approach lending institutions with a record of losses, and are seeking to buy aircraft with a limited resale market.

The C.A.B.-sponsored loan guarantee scheme helps, but it is also important for the operators to show that their new equipment will have a good earning capacity. Bonanza made an analysis of the introduction of six F-27s on their existing route system and found that in the first full year of normal operations the break-even subsidy requirement will be nearly halved. With six F-27s replacing the fleet of 10 DC-3s, routes strengthened in certain areas and authority to conduct skip-stop service on several route segments, Bonanza should be off subsidy by 1964.

Bonanza's financial commitment on F-27s is in excess of five million dollars, compared with a total capital investment in the present DC-3 fleet of approximately a million dollars. But the local service airlines could not afford not to re-equip. There is too much to be gained by taking the big leap into turboprops. It makes economic sense to pay the cost of aircraft that are so vastly superior in every way to those now operated.

"*Operation Planning for Introducing New Aircraft Into a Local Service Airline System*," by T. H. Davis, president, Piedmont Airlines.

THE first aeroplane built in the U.S.A. in response to the requirements of the local service airlines is the Fairchild F-27, which has been ordered by six of these airlines to date. Its integration into these airline fleets offers a definite challenge, to meet which Piedmont have embarked upon a major—and expensive—planning and training programme.

The basic programme is in two parts, covering equipment procurement and personnel training, the latter including aircrew, aircraft and engine mechanics, communication and electronic mechanics and station servicing personnel. About 75 pilots are to be trained before the start of scheduled service (and the remainder as required), the pilots course comprising 96 hours in the classroom equally divided between airframe and engine, plus 10-12 flight hours on the F-27. All the company's aircraft and engine mechanics will be trained on the F-27, and will take a 208-hour course, plus a special "on-the-job" training programme when the F-27 is delivered.

Piedmont are conducting all their own engine training, with the help of the Rolls-Royce Dart training kit. Four engineers have attended the Rolls-Royce school at Derby and the Rotol school at Cheltenham. The fuel suppliers have sent "visiting professors" to instruct in jet fuel handling. The Piedmont engine school has been attended by representatives of other airlines (some foreign), the C.A.A. and business corporations which will use the F-27.

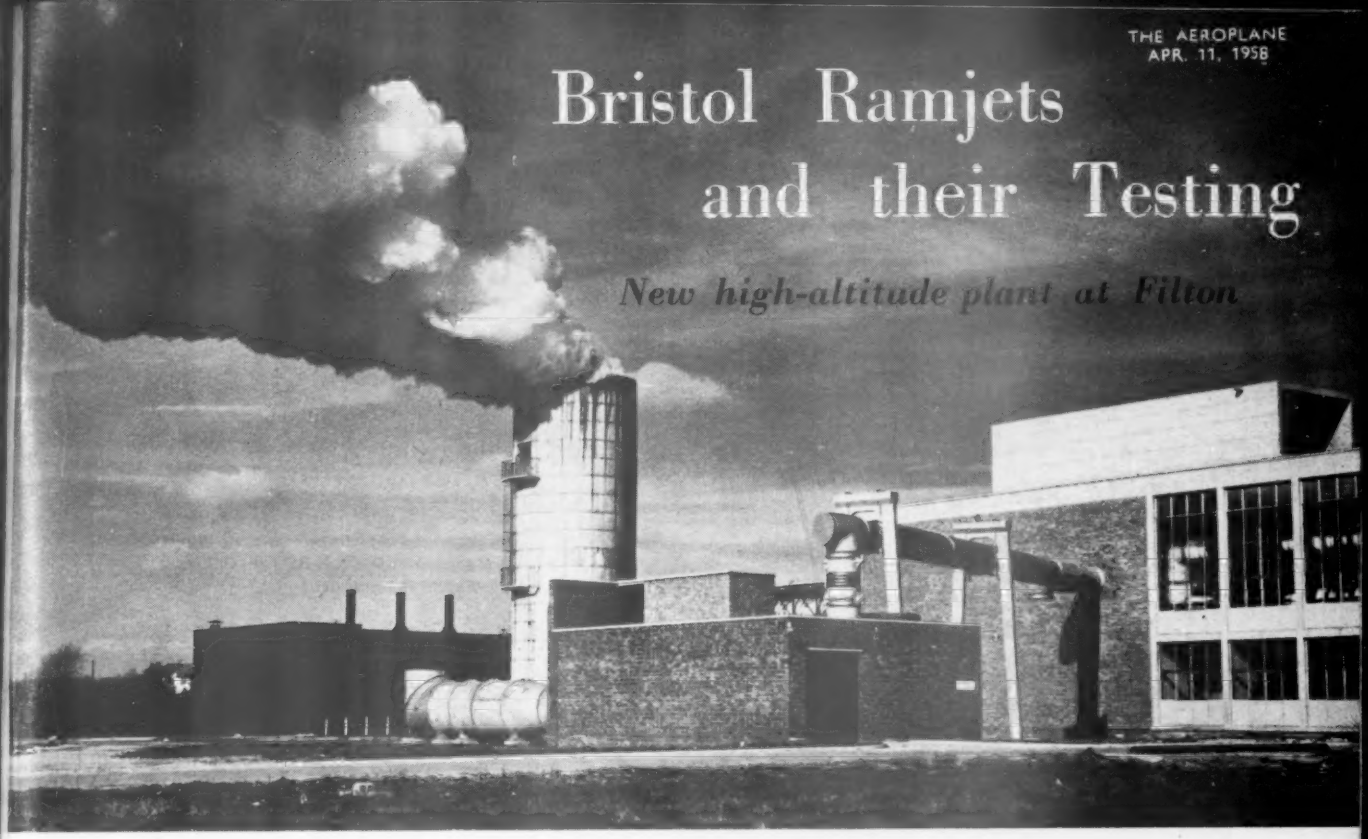
Factory service schools have been utilized for instruction in communications and electronics. Station managers and chief agents from each station will take a two-day course on the F-27 before it goes into service, to acquaint them with servicing and loading techniques, which will also be demonstrated during proving flights.

The introduction of turboprop engines has called for quite extensive new equipment, including special fuel storage facilities and refuelling units at most fuelling stops, and water-methanol tanks and pumps. Special tools will be required at each maintenance base for the engine, propeller and airframe, with the added complication that engine and propeller bolts and nuts are in Whitworth sizes. All line maintenance and major overhaul functions on the airframe will be tackled by Piedmont, but Dart overhauls will initially be contracted out to another airline. When the Piedmont fleet of F-27s exceeds the 12 units at present on order—probably by the end of 1959—the airline will tackle its own engine overhauls, too.

* We here use Fairchild's "F dash 27" style; the Fokker style used on previous pages is to use a point rather than a dash.

Bristol Ramjets and their Testing

New high-altitude plant at Filton



AS one might expect, Dr. R. R. Jamison, chief ramjet engineer of Bristol Aero-Engines, Ltd., is an ardent ramjet enthusiast. In a recent interview he outlined past Bristol work in this field and possible future application for ramjets. He went on to speak of the company's vast new ramjet test facility—the subject of this article.

Ramjet work at Bristol began after the concept of the Bloodhound ground-to-air-missile had been decided. The Bloodhound was the outcome of a detailed study made jointly by Bristol Aircraft, Ltd., and the Royal Aircraft Establishment. Ramjet power was chosen to ensure flexible operation over long ranges.

In 1950 Bristols collaborated with the R.A.E. on the development of a 6-in. diameter ramjet, and flight tests were made with this engine. The programme for the Bloodhound was then accelerated and to save time Bristols signed a collaboration agreement with the Boeing Airplane Co., which at that time had considerable ramjet experience. The engine resulting from this collaboration was the basic unit which led, after much development, to the Thor ramjet which powers the Bloodhound.

It was test work on the Thor which showed the need for new facilities. Using spill-diffusion techniques the Thor ramjets could be tested on sea-level plant up to a simulated altitude of 33,000 ft. Performance at higher altitudes, however, could not be studied except by using costly test vehicles. Thus, late in 1953 Bristol was given permission to go ahead with the new high-altitude test plant which allows engines such as the Thor to be tested to their operational limits and enables more advanced engines to be developed.

The plant can, therefore, be used for testing engines such as the B.R.J.801 18-in. ramjet which was shown by the company at Farnborough last year.

Discussing future applications for ramjets, Dr. Jamison said that in terms of weight they were the most efficient means of imparting high kinetic energy to a missile. For example, if a ground-to-air missile were accelerated by ramjet to Mach 4.5 in the atmosphere it could then climb to over 300,000 ft. Ramjets could provide the best power unit for a ballistic missile.

For high-speed manned aircraft, combined ramjet and turbojet powerplants were ideal, said Dr. Jamison. Bristol studies have shown that this combination is the most efficient for Mach numbers above 2.5. The ramjet and turbojet would have a common air intake. Powerplants of this type demanded a new approach to design; for example, the ramjet might form an integral part of a ducted wing

The new Bristol high-altitude test plant enables ramjet performance to be studied under high-speed and high-altitude conditions. An accompanying graph shows the range of operational conditions for which ramjets of different sizes can be tested. Speeds up to Mach 3.5 and altitudes up to 100,000 ft. can be simulated. The capacity of the plant can easily be extended if this should be necessary in future.

A ramjet depends for its thrust on ram compression in its intake; it can thus only be tested effectively if it is placed in an airflow of the appropriate speed. In the Bristol high-altitude plant the ramjet under test is run in a cylindrical cell. Its intake is supplied with air at the required Mach number by feeding compressed air, cooled or heated as conditions require, to a convergent/divergent blowing nozzle. Air supplied to this nozzle must normally be heated to the total temperature of the airflow at the test Mach number. The static temperature of the air falls as it is accelerated through the nozzle to supersonic speed. Different nozzles are used for different Mach numbers.

To simulate altitude conditions the test-cell pressure is reduced by suction from a series of steam-operated ejectors. They remove the surplus air supplied to the cell, as well as the ramjet exhaust gases fast enough to maintain reduced pressure in the cell.

The test plant can be operated in three different ways to test ramjets under low-, medium- and high-altitude conditions.

For low-altitude tests the steam ejectors are not needed. Compressed air, heated or cooled as required to achieve the test Mach number, is supplied to the blowing nozzle. Tests are normally made under constant speed and altitude conditions, but ramjet launching can be simulated by increasing the pressure of air supplied to the blowing nozzle at an appropriate rate.

For medium-altitude tests (20,000-50,000 ft.) the steam ejectors lower the test-cell pressure and, as in the previous cases, heated or cooled compressed air is supplied to the blowing nozzle.

For tests at high-altitude conditions—equivalent to 50,000 ft. or higher—only the steam ejectors are used. No compressed air is supplied to the blowing nozzle; intake air is sucked through the heaters and into the test cell via the blowing nozzle. For such tests the ejectors can reduce test-cell pressure to 1.5 p.s.i. absolute. Speeds up to Mach 2.5 can be simulated

at altitudes from 30,000 ft. up to 90,000 ft. and speeds up to Mach 3.5 at heights from 60,000 ft. up to 100,000 ft.

In all these tests the blowing nozzle provides a jet of air slightly larger in diameter than the ramjet intake. The nozzle is arranged so that shock-wave reflections from the jet boundary do not interfere with flow into the engine; in this way the ramjet experiences the exact conditions it would meet in flight at the simulated altitude and Mach number.

Air Supply

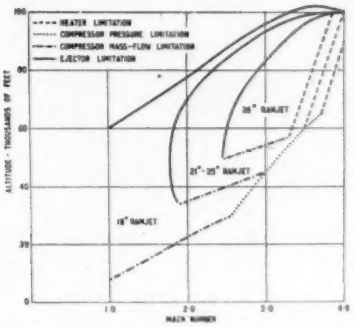
Compressed air for the test plant is supplied from an air station where four Proteus 3 compressors are driven by electric motors; they deliver an airflow of up to 150 lb./sec. at a pressure ratio of 6 : 1 or 84 lb./sec. at a pressure ratio of 8 : 1. In the test plant this air can be led direct to the blowing nozzle or it can be heated or cooled beforehand. The air from the compressors is at 260° C.; for a test run at a mass-flow of 80 lb./sec. the air can be raised to 450° C. for 10 min. by passing it through a storage air heater. This heater is a 1,500-kW. electric unit with a matrix weight of 36 tons and a capacity of 4.5 million C.H.U.; charging it takes 4 hr.

Cooling is by water-cooled radiators, which can lower the temperature of 160 lb./sec. of air from 260° C. to 95° C. Both the heater and the coolers are in parallel with the main air supply; valves enable the appropriate quantities to be heated or cooled so that air at the correct temperature is supplied to the blowing nozzle.

The cell in which the ramjets are tested is 75 ft. long and 10 ft. in diameter, with an exhaust outlet 5 ft. in diameter. The ramjet under test is mounted on a swinging stand and can be viewed through glass windows, which are water-cooled. An airstream flowing at the required Mach number is supplied by the blowing nozzle immediately ahead of the ramjet.

A door 20 ft. long and weighing 10 tons is provided for the cell; this can be opened to give access to the ramjet between runs. Inside the cell the ramjet exhaust is cooled by water spray-rings; a "bullet" in the core of the exhaust jet reduces the length of the flame and helps cooling.

At the end of the test cell is a duct leading to the steam ejectors and silencing tower through which exhaust air and fumes escape or are sucked, depending on the altitude which the test simulates. Waste cooling water is pumped from the cell.



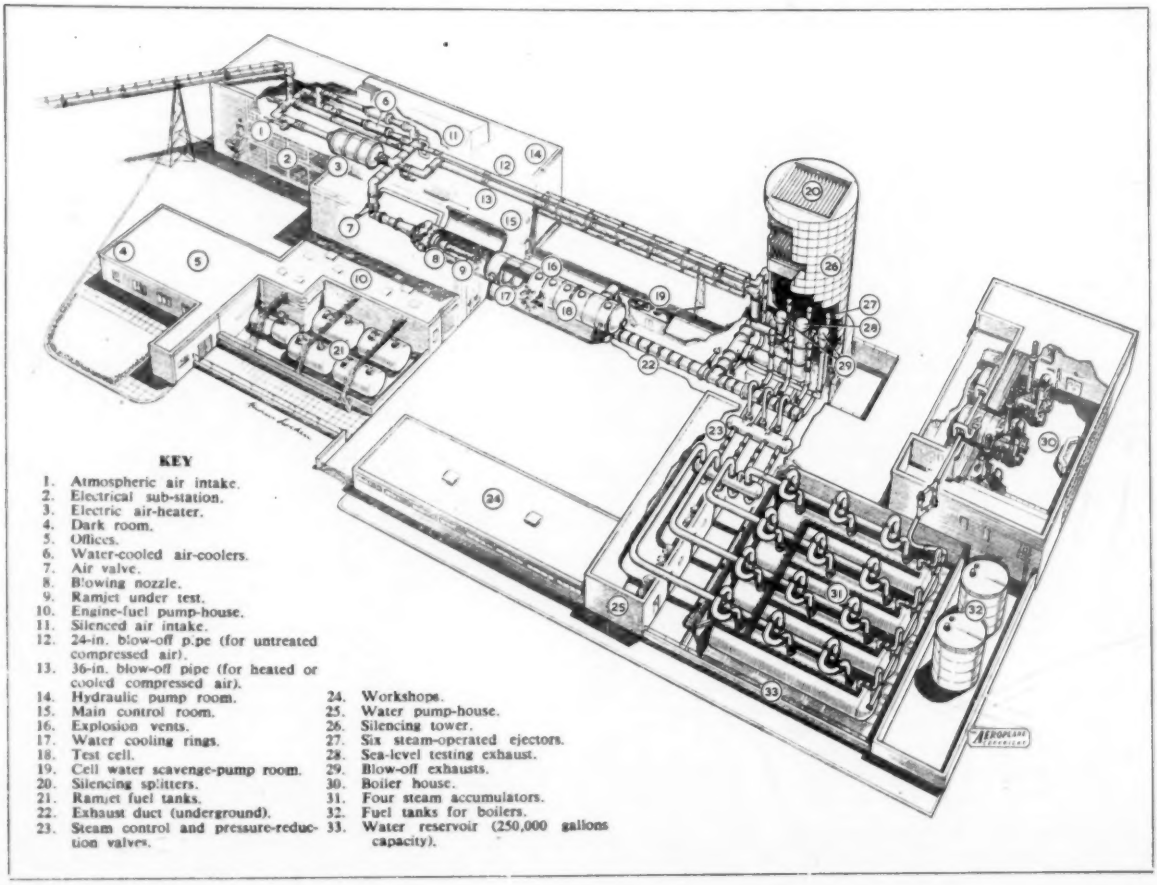
The conditions under which ramjet operation can be simulated in the test plant are shown for ramjets varying in diameter from 18 in. to 26 in. The graph is based on free-jet testing in which half the air passing through the blowing nozzle enters the ramjet under test.

Numerous precautions are taken to avoid test-cell explosions. The cell has glass windows in its roof which are shattered by explosive charges if the internal pressure exceeds 25 p.s.i. absolute. A detector in the first elbow of the exhaust duct releases chloro-bromomethane into the duct if the flame should reach this point. Should a fire break out all fuel supplies to the cell can be cut off immediately and CO_2 pumped into it.

Instrumentation and Test Technique

Information about the ramjet under test is transduced into electrical signals and recorded on Honeywell-Brown trace instruments. Typical quantities measured are the pressures and temperatures at different points, fuel flows and thrust. Nozzle, intake and combustion entry pressures are always recorded. Other records are made by photographing banks of instruments.

(*Continued on page* 519)



KEY

1. Atmospheric air intake.
2. Electrical sub-station.
3. Electric air-heater.
4. Dark room.
5. Offices.
6. Water-cooled air-coolers.
7. Air valve.
8. Blowing nozzle.
9. Ramjet under test.
10. Engine-fuel pump-house.
11. Silenced air intake.
12. 24-in. blow-off pipe (for untreated compressed air).
13. 36-in. blow-off pipe (for heated or cooled compressed air).
14. Hydraulic pump room.
15. Main control room.
16. Explosion vents.
17. Water cooling rings.
18. Test cell.
19. Cell water scavenge-pump room.
20. Silencing splitters.
21. Ramjet fuel tanks.
22. Exhaust duct (underground).
23. Steam control and pressure-reduction valves.
24. Workshops.
25. Water pump-house.
26. Silencing tower.
27. Six steam-operated ejectors.
28. Sea-level testing exhaust.
29. Blow-off exhausts.
30. Boiler house.
31. Four steam accumulators.
32. Fuel tanks for boilers.
33. Water reservoir (250,000 gallons capacity).

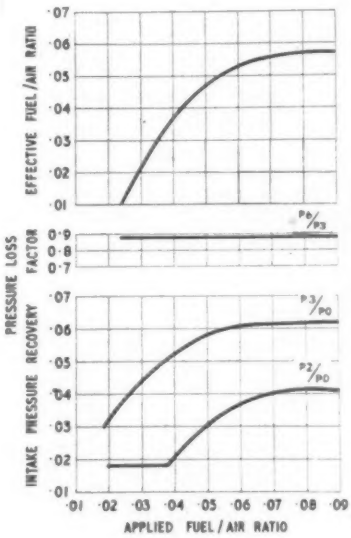
In the main control room the test-plant conditions are regulated from the left-hand panel, above which is a diagram showing valve positions. The engine on test is controlled from the right-hand panel; it can be watched through water-cooled windows in the test cell.

(*Continued from page* 518)

using the auto-observer technique of aircraft test-flying. More than 100 recordings can be made simultaneously.

High-frequency pressure variations are tape-recorded and the results reduced by means of a frequency analyser. Intake shock-wave patterns are recorded by shadowgraph photography.

All the test results are recorded in a central data room which is some distance from the test cell. Information from the recordings is transferred to punched cards and fed into an English Electric Deuce computer which analyses the results.



Typical test results for a ramjet engine are shown on these graphs. P_0 is the total pressure upstream of the intake, p_2 the ramjet intake-lip static pressure, p_3 the combustion chamber static pressure, P_3 the combustion chamber total pressure and P_6 the total pressure at the exhaust nozzle throat

Test runs are limited in length and each is fully programmed to give the maximum of information. During a 2-min. test run the full range of engine performance at one speed and altitude can be measured. Thrust is varied by an inching device which regulates the fuel/air ratio control on the ramjet so that performance can be measured over a full range of ratios.

Steam Plant and Silencing Towers

Steam for the suction ejectors is provided by three boilers which together raise 38,000 lb./hr. at 250 p.s.i. This steam is stored in four heavily lagged accumulators, each 64 ft. long and 12 ft. in diameter. Their total steam capacity is 98,000 lb.; they can be charged from the minimum working pressure to 250 p.s.i. in 2½ hr.

Between the accumulators and the ejectors the steam passes through valves arranged in parallel which reduce its pressure to 120 p.s.i. absolute.

The outlet pipe from the test cell passes underground to the base of a silencing tower, where it branches into three. The central branch allows the test-cell exhaust to blow off at atmospheric pressure; each of the other branches is connected to three steam ejectors. These ejectors can be fitted with either small or large nozzles. Releasing the stored steam at the maximum rate through the small nozzles takes 8.2 min.; with the large nozzles the time taken is 6.8 min. The number of nozzles used depends on the degree of suction to be applied to the test cell.

The steam nozzles and test-cell exhaust eject up a tall silencing tower filled with banks of acoustic splitters. Also exhausting up the tower are the two blow-off pipes for the compressed air which by-passes the test cell before and after test runs.

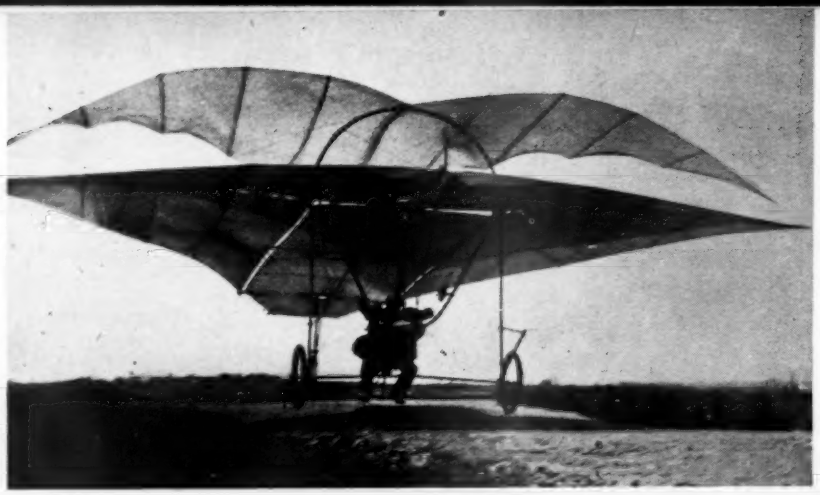
This test plant was constructed rapidly because it makes use of virtually standard steam equipment. It is more than adequate for testing Bristol ramjets under development at present, but its capacity can easily be extended in future by the simple expedient of installing additional boilers and steam accumulators.

This use of standard steam equipment has already paid dividends by keeping the cost of the plant to a reasonable level. It should, moreover, also pay off in the future—for as we have said it will enable extensions to be made easily and cheaply should the need arise.—J.R.C.

Sub-contractors and Suppliers

Plant and Equipment: Audley Engineering Co., Ltd.; Automotive Products Co., Ltd.; Avery-Hardoll, Ltd.; Babcock and Wilcox, Ltd.; Barnet Instruments, Ltd.; Boma Engineering Co., Ltd.; Frederick Braby and Co.; Bristol Steel Services, Ltd.; David Brown Industries, Ltd.; Bryans Aeroquipment, Ltd.; Budenburg Gauge Co.; Central Electrical, Ltd.; J. S. Chinn, Ltd.; Cochran and Co. (Annan), Ltd.; H. Cooper and Sons, Ltd.; Crypton Equipment, Ltd.; Drysdale and Co., Ltd.; Edwards' High Vacuum, Ltd.; Electric Construction Co.; Enfield Cables, Ltd.; English Clock Systems, Ltd.; English Steel Corp., Ltd.; Everett Edgcumbe, Ltd.; Exactor, Ltd.; Fielden Electronics, Ltd.; Fire Armour, Ltd.; Firkins and Co., Ltd.; Foster Instrument Co., Ltd.; Gardiner, Sons and Co., Ltd.; Glanmore Foundry Co., Ltd.; Godwin Warren (Eng.), Ltd.; Gordon and Co.; Graviner Manufacturing Co., Ltd.; Harland Engineering Co., Ltd.; Harringay Photographic Suppliers, Ltd.; Hick, Hargreaves and Co.; J. H. Hodges and Co., Ltd.; Honeywell-Brown, Ltd.; Hopkinsons, Ltd.; Incandescent Heat Co., Ltd.; C. E. Kidd and Son, Ltd.; Klaxon, Ltd.; Richard Klinger, Ltd.; Llewellin and James, Ltd.; Lockers (Metal Perforators), Ltd.; Lockheed Hydraulic Brake Co.; Mechanair, Ltd.; Mechans, Ltd.; Metropolitan-Vickers Electric Co., Ltd.; Millspaugh, Ltd.; Munro and Miller, Ltd.; W. J. Naylor and Co., Ltd.; Newalls Insulation Co., Ltd.; New Western Engineering Co.; Oil Feed Engineering Co., Ltd.; Optical Works, Ltd.; A. and S. Osmond, Ltd.; Oswald and Ridgeway, Ltd.; Pickfords Heavy Haulage Service; Pilkington Brothers; Precision Tool and Instrument Co., Ltd.; Pulsometer Engineering Co., Ltd.; Pumps and Equipment, Ltd.; Reed and Crane Hoist Co., Ltd.; Rellumit (London), Ltd.; Rheostatic Co., Ltd.; Rotameter Manufacturing Co., Ltd.; Rotax, Ltd.; Rotork Engineering Co., Ltd.; Ruths Accumulators (Cochran), Ltd.; Sangamo Weston, Ltd.; Sankey Sheldon, Ltd.; Saunders Valve Co., Ltd.; Serck Radiators, Ltd.; Sheffield Testing Works, Ltd.; Sloan Electric, Ltd.; Smiths Aircraft Instruments, Ltd.; Spares and Equipment, Ltd.; Standard Telephones and Cables, Ltd.; Teddington Aircraft Controls, Ltd.; Teleflex Products, Ltd.; G. F. Tuckey, Ltd.; Turner Bros. (Asbestos) Co., Ltd.; Varley Pump and Engineering Co.; Veeder Root, Ltd.; Vokes, Ltd.; Welding Industries, Ltd.; Whessoe, Ltd.; Williams and James (Engineers), Ltd.; Woodberry Chilcott and Co., Ltd.; Worthington Simpson and Co., Ltd. **Buildings and Services:** Bristol Glaziers, Ltd.; British Reinforced Concrete Engineering Co., Ltd.; Broads Manufacturing Co., Ltd.; Burgess Products Co., Ltd.; Cementation (Muffelite), Ltd.; Chatwood-Milner, Ltd.; Flexi-Mastic Roofs and Asphalt, Ltd.; Gardiner, Sons and Co., Ltd.; Helicon, Ltd.; E. W. King and Son (Newport), Ltd.; Sir Alfred McAlpine and Son, Ltd.; Modern Engineering (Bristol), Ltd.; Potter Rax, Ltd.; Arthur Scull and Son, Ltd.; Semtex, Ltd.; Spry and Holman, Ltd.; E. Wood, Ltd.; Stevens and Adams, Ltd.

Denmark's Air Pioneer



PEOPLE generally know little about the Danish aviation pioneer J. C. H. Ellehammer who flew (unfortunately without official observers) on September 12, 1906. A good deal of information about his early efforts was published when the 50th anniversary of his first flights was celebrated in 1956 and, in view of the recent Farman celebrations in France, it may be timely to recall some of the facts.

Born on June 14, 1871, Ellehammer spent his childhood on the island of Falster where he got accustomed to windmills, kites, sailboats, iceboats, etc. He was apprenticed to a watchmaker and from 1889 he worked as an electrician. In 1896 he started his own firm or "laboratory."

What actually induced Ellehammer to take up aviation is unknown. But he got the idea that if he could develop an engine light enough, and solve the stability problem, then he could turn the man-lifting kites of his childhood into an aircraft heavier than air.

Having gained experience of motorcycle engines he made his first aero engine in 1903-4. This was a 3-cylinder stationary radial air-cooled engine, developing 9 h.p. and weighing no more than 5 lb. per h.p. This seems to be the first radial air-cooled engine in the World, Langley's of 1902 being water-cooled.

After having made model experiments using a falling weight to provide thrust and having studied the birds, particularly the storks, Ellehammer in 1905 built a full-scale aeroplane. This was a monoplane with a central half-cylinder in which the airscrew worked. Unlike many other pioneers he used a wheel-undercarriage and the whole structure was a steel-tube construction. Pilot and engine functioned as pendulum to control the elevator automatically.

To be able to conduct his experiments in the quiet he borrowed a small island, Lindholm, north of Lolland. Late in 1905 his brother Vilhelm and his cousin Lars Ellehammer (the latter is still alive) built a hangar and a workshop and made a track. As the island was only some 600 feet wide the track was made circular, so that the aeroplane would be "pole-flying" round a central pylon. In this way he also got rid of problems of lateral and directional stability for the time and could concentrate on the longitudinal.

The first tests were performed on January 14, 1906, without a pilot on board, but with the "autopilot" working. The aeroplane lifted a little, and Ellehammer and his assistants were very happy and optimistic. The first experiments had shown that the engine was not powerful enough and that the surface of the track was too uneven, so he ordered his assistants to make it into a concrete runway—probably the first concrete runway for aeroplanes.

A new 3-cylinder engine with fewer cooling ribs was built. It developed 18-20 h.p. for a weight of only 3 lb. per h.p. Being too busy with his factory it was not until the end of July, 1906, that he continued the experiments on Lindholm.

The new engine proved successful, but now the aeroplane was too small in comparison with it. During the summer Ellehammer made numerous alterations. A second wing was fitted on top of the half-cylinder making the aircraft into a biplane.

On August 28 the aircraft lifted several times, both with and without the pilot on board. In the beginning of September results were even better, and, on September 12, Lars Ellehammer wrote in his diary:

> "Tried the airship on the track. Wind 2-3 metres. Direction N.E. Drove around the whole track, soared with both front and rear wheels about 42 metres, at a height of 1½ foot when it turned into the wind. Ellehammer on board the whole time. Took pictures of it in the air."

Ellehammer considered the first chapter completed. He had proved that it was possible to fly with an aircraft heavier than air. He continued his experiment near Copenhagen, now flying in a straight line. A film from that time shows that he at first continued with the same wing arrangement, but with a different fuselage structure.

In 1907 he used the same structure for a triplane with tapered wings. It was powered by a new engine, a 5-cylinder of about 30 h.p., developed from his second engine and driving a two-blade all-metal propeller. However, the third wing did not prove satisfactory, so in 1908 he made it into a biplane with the same 5-cyl. engine, but now with a four-blade propeller. Hitherto the wings had been of flat section, but the lower wing of this biplane had a cambered section. On January 14, 1908, he flew 170 metres at a height of 2 or 3 metres.

With this biplane he was invited to Kiel, Germany, for the Kiel-week from June 28 to July 5, 1908, where a prize had been offered for a flight of one-minute duration. Of 14 competitors only Ellehammer was able to fly. After a successful demonstration flight the committee wanted him to fly before the public next day. As the field was only about 450 yards long and the weather bad with a wind of 30 ft./sec. he was reluctant to do this. But as 30,000 onlookers, including Prince Heinrich, brother of the Kaiser, were waiting, the committee induced him to fly, promising him the 5,000 marks, even if a one-minute flight was not possible in the small field. So Ellehammer made a flight of 11 seconds. This is said to have been the first heavier-than-air flight in Germany.

In 1909 Ellehammer wanted to see if it was possible to take off from water, and so he built a biplane flying-boat with folding wings, elevator in front of the wings, and tailplane and rudder aft. It was said to have functioned satisfactorily.

The same year he also constructed his 1909 "standard-monoplane" which still exists. It has a fuselage of triangular cross section, steel-tube construction, normal wheel undercarriage, and the wing which can be folded has a steel-tube spar and is braced by wires. The pilot functions as pendulum for automatic stabilizing control, both longitudinally and laterally. The engine used was a 6-cyl., 40 h.p. air cooled and stationary, consisting of two rows of 3 cylinders each.

Ellehammer also made a helicopter, first a large model in 1911, and in 1912 a full-scale helicopter. This "rotating aeroplane" as he called it, had two co-axial counter-rotating rotors each consisting of six rotor-blades placed at the periphery of a ring. The lower ring was covered to provide lift in forward flight. The rotor system was driven by one of his 40-h.p. engines through a hydraulic clutch and a gearbox which reduced the 1,100 r.p.m. of the engine to 64 r.p.m. for the rotors. The engine also drove a normal propeller for cooling and forward flight. The rotor-blades had a patented system of cyclic pitch intended to make the helicopter stable.

Ellehammer made many tethered flights with this helicopter, being observed by well-known aviators (among these H.R.H. Prince Axel) and scientists in 1912. Next year it was demonstrated before a French commission and lifted itself (630 lb.), a man and a further 214 lb.—a total weight of 1,000 lb. The lift was so strong that one of the moorings broke and the aircraft was severely damaged. After this he stopped his experiments.—PER WEISHAUPT.

PRIVATE FLYING

H.J.C.'s Club Commentary:

● WHIT-SATURDAY, May 24, has been selected by the **Cheltenham Aero Club** for a tea patrol; the time is 15.30 hrs. to 16.00 hrs. On June 28 the two local branches of the R.A.F.A. are organizing an air display at Staverton.

The Such Navigation Trophy is being contested, the first fly-offs having taken place over the week-ends of March 22-23 and March 29-30.

Another Autocrat has just been added to the club fleet; a Tiger Moth will probably be added later, solely for providing aero-tows at the Bristol Gliding Club's site at Nympsfield and elsewhere.

ITALIAN FOUR-SEATER — Latest product of the Partenavia company of Naples is the P.157 Fachiro (Fakir), powered by a 150-h.p. Lycoming O-320 engine. It has a maximum speed of 143 m.p.h. and weighs 1,990 lb. loaded.

● WHEN petrol rationing was imposed at the end of 1956 the **Elstree Flying Club** withdrew its Gemini from service, and later found that a modified training policy did not justify its return; but advanced tuition now makes a twin-engined aircraft again necessary and, with the co-operation of the **North Middlesex Flying Group,** another Gemini—G-AIIF—has become available. The flying rate is £8 an hour, dual or solo, or £9 at night.

Some changes have also taken place with regard to the rest of the fleet. The Hawk-Trainer 3, G-AKKR, has been sold, as has another, G-AHYL, but this one remains at Elstree in the hands of the **Westbourne Flying Group.** Autocrat G-AGVN has also gone, so the Elstree club's fleet now consists of Chipmunks G-AOSN, AOSO and AOSY; Hawk-Trainers G-AIUA, AKPF and AKPG, and Autocrats G-AGTP and AGXT. The two Autocrats are eventually to be converted to Alphas.

● TO CELEBRATE the 10 years of service which Mr. Derek (or "Wilbur") Wright has given to the **Denham Flying Club,** a party was given on March 13 by Mrs. Bickerton. Wilbur has devoted a great deal of time to furthering the club, and apart from being C.F.I., he is also managing director, secretary and aerodrome controller. A good crowd of people turned up to record their appreciation and he was presented with a watch while Mrs. Wright received a handbag.

Among the instructors at the club, Miss Janet Ferguson has now qualified for a full instructor's rating.

The club is now operating two Aiglets on behalf of the Airways Aero Club, along with an Alpha.

● FLYING TIME in February attained an "all-time low" at Roborough, according to the **Plymouth Aero Club's** latest newsletter, 85 hr. 20 min. being recorded. During the month two P.P.L.s were gained—by Cdt. Sgts. A. W. Miller and C. S. Tredinnick—and Mr. C. Carver has passed his technical examination for the C.P.L. Mr. Roy Crook, the airport controller, has left to take up similar duties at Exeter, and has been replaced by Mr. Stanley White, who for the last three and a half years has been a controller at R.A.F. Cranwell.

The first of this year's patrols will be on April 27, when the club attacks Exeter for breakfast.

In addition to the air display scheduled for June 14, the club is also to hold an air rally. It will be from August 2 to 4 and arranged in association with Plymouth Navy Week.

GLIDING NOTES

NEWLY designed for the Open Class in this year's World Gliding Championships, the Olympia 419 (illustrated last week), a modification of the laminar-flow Olympia 4, had its first flights on March 29 at Thruxton aerodrome. David Ince had one hop and then three aero-towed launches, from which he went through a full range of handling checks during a total flying time of 2 hr. This machine is to be flown in the contest by Nicholas Goodhart.

Meanwhile the Skylark 2, which Philip Wills is to fly in the restricted 15-m. class, has been delivered by Slingsby at Dunstable, where Wills has brought his own Skylark 3 so that its instruments can be transferred to the other machine.

The seeded pilots for the United States team at the Championships are: Paul MacCready, Paul Bikle, Lyle Maxey, William Ivans, Stan Smith and Francis Compton. However, MacCready has had to give up his place because of business commitments.

* * *

IN Poland the Soaring Flight Institute is producing a special version of the much-used Mucha (Fly) for the 15-m. class. Of wooden construction, the general design is by W. Nowak with details by R. Grzywacz. Its wing has a straight taper with a mean aspect ratio of 17.6, A. Zientek writes. The empty weight is 463 lb. and the all-up weight 705 lb., giving a wing loading of 5.14 lb./sq. ft. (25.1 kg./sq. m.). Maximum permissible speed is 155 m.p.h. (250 k.p.h.). There are streamlined "shapes" not only at the wing-tips but at the tips of the tailplane also.

* * *

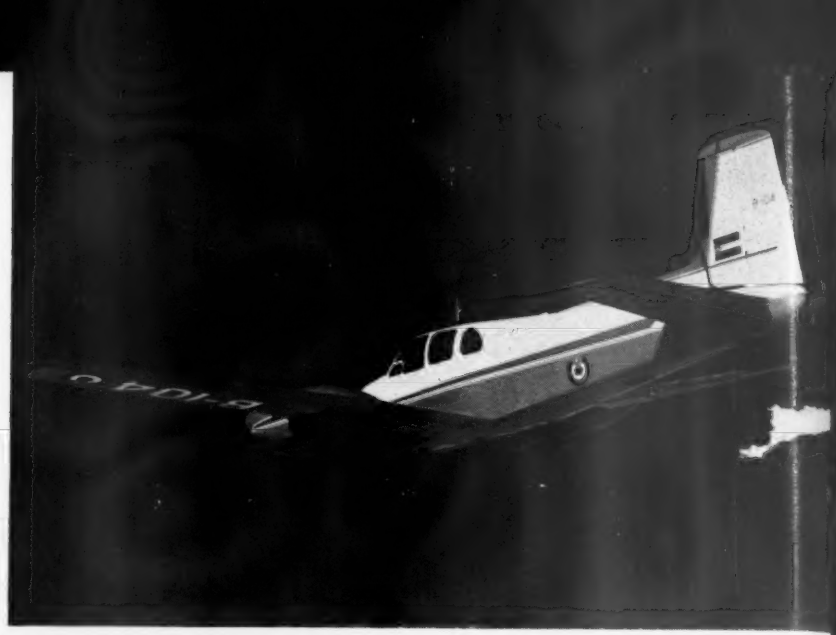
AT least 700 guests, Polish and foreign, are expected at Leszno during the World Championships, J. Orwovski writes, and a correspondingly large camp is being built. A Polish entry in the Open Class may be the new Zefir, if it can be got ready in time; it embodies "the concentrated experience of the whole Polish gliding movement and industry." In fact, it is one of those "super" productions which can contribute much to the advancement of sailplane design, but whose expense has led to the institution of the "restricted class" so as to encourage designers and manufacturers to give some attention also to producing cheap and robust sailplanes for the average user.

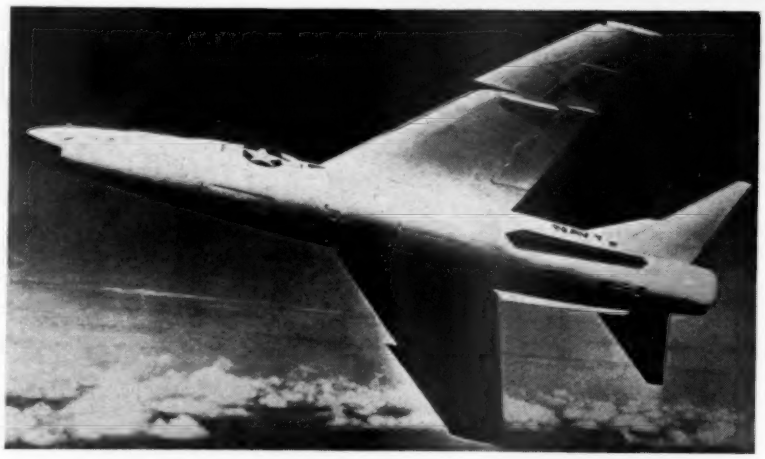
* * *

THREE new French sailplanes are to fly this year, Mr. Pratt says. The Breguet 905, made for the Standard Class with a span of 15 m., has a calculated gliding angle of 1 in 32 at 45 m.p.h.; it has a V-tail and weighs 250 kg. (551 lb.); it is to be sold in kit form. The firm's stratospheric sailplane, designed to cope with heights up to 16,000 m. (52,500 ft. or just under ten miles), is also "scheduled" to fly this summer; its wing area is 40 sq. m. (431 sq. ft.). The Wassmer firm is bringing out a two-seat version of the Javelot.—A. E. SLATER.

FLIGHT TEST.—As recorded on this page, Mr. David Ince, here seen in the cockpit, made the first flight of the new EoN Olympia 419 sailplane at Thruxton on March 29.

NEWS IN PICTURES





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Above, first picture of the newest version—the F8U-2—of the Chance Vought Crusader naval fighter. The first commercial jet helicopter operation in America began on March 12 when the Aetna Helicopter Corporation, of Etna, Calif., took delivery of the first Sud-Aviation Alouette II (see below) assembled by the Republic Aviation Corporation.

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Helicopters Out East

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(Chief Helicopter Test Pilot, Bristol Aircraft, Ltd.)

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The Cost of Flying

AFTER half a lifetime of enjoyable motoring I decided some time ago that, for real ease and comfort, it would be necessary for me henceforth to take to the air in a helicopter. I investigated the position—I was dismayed.

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I discovered that a leading school charges £34 per hour for helicopter instruction, and that I, an elderly learner of 43 years, must first have a private aeroplane licence before I can fly a helicopter—I would be prepared to do this but why must I if the flying of the two types of aircraft is so different?

The future of British aeroplane manufacturers might perhaps be brighter if they were able to satisfy my ilk.

Dungannon. CONN MCCLUSKEY.

The Autogiro Up to Date

From Maj.-Gen. H. Parham, C.B., C.B.E., D.S.O.

"SOUTH AFRICAN'S" idea (THE AEROPLANE, April 4) of reverting to the Autogiro C.19 Mk. III idea of blowing the rotor round by deflected slipstream, and then giving the final boost by solid rockets is intriguing—but certain snags occur to me and I am not quite sure if I like it all that.

Snag No. 1. The old C.19 had a four-bladed rotor with wide-chord blades. Therefore during every revolution quite a lot of blade was in the diverted slipstream. But even so it was a long, laborious and not very efficient business, and I doubt if the rotor got anywhere near flying speed. With modern two- or three-bladed rotors with narrow-chord blades surely the idea would be even less efficient. In fact probably slightly larger tip-jets or rockets would do the initial revving up with less pain and grief.

Snag 2. The complicated tilting tail would add to cost and weight (and probably to drag). Would it be worth it?

Snag 3. A quick take-off (hard ground, headwind) would leave the rockets burning *after* take-off. Probably O.K. but one would want some "gen" about it.

Re the solid rocket idea. Cordite is *out* . . . too violent, too short-burning, comes under the "Explosives Act," etc., etc.

This leaves "Jetex" type (*à la* model aeroplane). I believe that recently there was something in "Gliding Notes" about possible costs of rocketry for sailplane launches in which Jetex was discussed and its cost found to be high. The problem of revving up a rotor is less severe than launching a sailplane to 2,000 ft. and might well be within the capabilities of Jetex. The snags are that each take-off would *appear* expensive to the operator (who always tends to forget that his aircraft had cost him less initially) and for school work or crop dusting, where many take-offs are needed, might prove too costly. But it is attractive, none the less.

As regards controls, I have in mind, of course, "direct control" of the rotor-head as in the C.30 and C.40 (tilting head) but it might well be, with modern know-how, that a simpler, lighter and "smoother" (i.e. less vibration to the hand) control would be possible.

This was, to my mind, the basic objection to the C.30 . . . it had a "hard mouth" (speaking in "horsey" terms). The C.40 almost quite got over all this so it could be done even in 1939. The fact that the rotor is not being driven must surely help.

I am quite, quite sure, there is a future for such a craft. It's silly to jettison simplicity when once you've had it and the complexity of the helicopter is due to its ability to fly sideways, backwards and to hover . . . none of which I want to do in my simplified design.

Hintlesham, Ipswich. H. PARHAM.

Groundabout

Ye Who Are About To Fade. . . . The current issue of the *Hawker Siddeley Review* provides grim evidence of The Trend. For the first time in its ten years, the journal carries neither pictures nor articles about aircraft. Just a couple of air news paragraphs at the back. At the recent Avro 504 Club dinner, "Dobbie" forecast that without aviation he would "just fade away." A likelier thing would be that without Sir Roy, aviation would fade away.

*

Croc. Spec. The "DC-3 replacement" should be amphibious and armour-plated, judging from conditions facing some DC-3s. For instance, Hunting-Clan African Airways' smart jobs couldn't use Kariba airstrip because of floods and, the authority's report might have added, "because of crocodiles." When the airfield controller sloshed out to check the depth of water on the runway, he had a feeling he was being watched—looking round, he found a croc. making a nice approach on instruments through the Zambesi's muddy overflow. The controller, who surely deserves some kind of recognition from the Guild of Air Traffic Control Officers, promptly closed the field and ordered an immediate diversion.

The DC-3 WREPLACEMENT

*

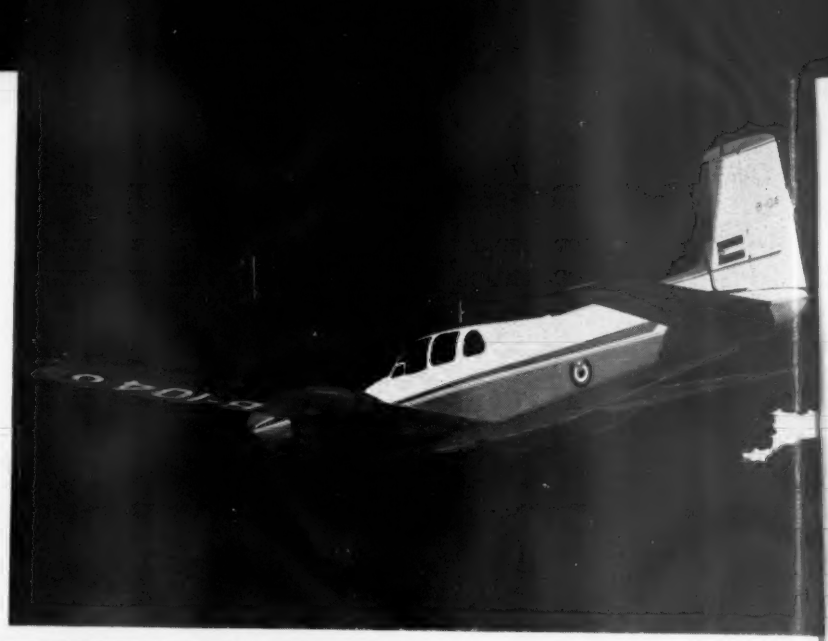
Down Wash. Ever hear of a helicopter having to drop anchor in a hangar? It happened at Sydney Airport when a rainflood had the T.A.A. hangar awash. A Bell on floats took off on the tide and had to be hastily moored.

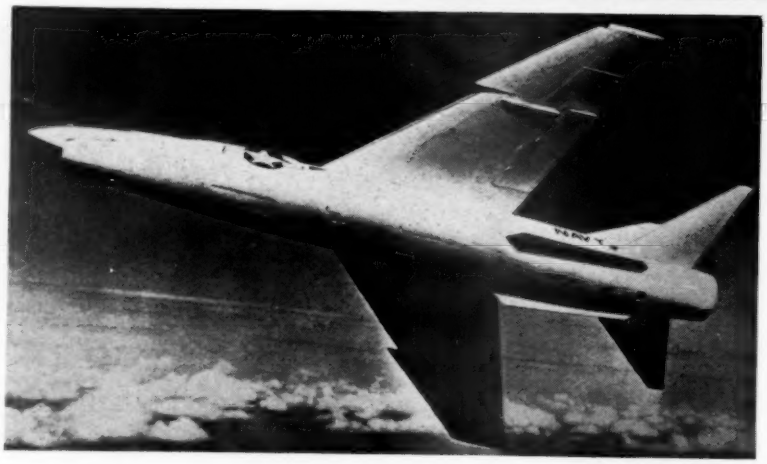
*

Hip-Hip-Hooray! The Thruxton Jackaroo designers, faced with packing four people into the smallest space, produced after a lot of research a lay-out which passengers on the new Economy Class airline services would find a blessing, I'm sure. The seats are not only slightly staggered, they are also set at differing levels, thus avoiding the hip-to-hip crowding which nobody likes.

by Lorenzo

NEWS IN PICTURES





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The Motor has a special page setting out prices of cars; in THE AEROPLANE price is rarely mentioned. Advertisers do not list the price of their aeroplanes or helicopters; indeed I am still unaware whether heavier-than-air machines attract purchase tax or not.

The small aero-engine, I read, uses about four pints of oil per hour—I am little interested in flying hours, I only want to know m.p.g. of petrol and oil. Further, I am bewildered by the fantastic price of a small aero-engine, the more when I think of the reliability and durability of, for example, the Jaguar car engine and its price—even surrounded by a car and wrapped up in purchase tax!

I discovered that a leading school charges £34 per hour for helicopter instruction, and that I, an elderly learner of 43 years, must first have a private aeroplane licence before I can fly a helicopter—I would be prepared to do this but why must I if the flying of the two types of aircraft is so different?

The future of British aeroplane manufacturers might perhaps be brighter if they were able to satisfy my ilk.

Dungannon. CONN MCCLUSKEY.

The Autogiro Up to Date

From Maj.-Gen. H. Parham, C.B., C.B.E., D.S.O.

"SOUTH AFRICAN'S" idea (THE AEROPLANE, April 4) of reverting to the Autogiro C.19 Mk. III idea of blowing the rotor round by deflected slipstream, and then giving the final boost by solid rockets is intriguing—but certain snags occur to me and I am not quite sure if I like it all that.

Snag No. 1. The old C.19 had a four-bladed rotor with wide-chord blades. Therefore during every revolution quite a lot of blade was in the diverted slipstream. But even so it was a long, laborious and not very efficient business, and I doubt if the rotor got anywhere near flying speed. With modern two- or three-bladed rotors with narrow-chord blades surely the idea would be even less efficient. In fact probably slightly larger tip-jets or rockets would do the initial revving up with less pain and grief.

Snag 2. The complicated tilting tail would add to cost and weight (and probably to drag). Would it be worth it?

Snag 3. A quick take-off (hard ground, headwind) would leave the rockets burning *after* take-off. Probably O.K. but one would want some "gen" about it.

Re the solid rocket idea. Cordite is *out* . . . too violent, too short-burning, comes under the "Explosives Act." etc., etc.

This leaves "Jetex" type (*à la* model aeroplane). I believe that recently there was something in "Gliding Notes" about possible costs of rocketry for sailplane launches in which Jetex was discussed and its cost found to be high. The problem of revving up a rotor is less severe than launching a sailplane to 2,000 ft. and might well be within the capabilities of Jetex. The snags are that each take-off would *appear* expensive to the operator (who always tends to forget that his aircraft had cost him less initially) and for school work or crop dusting, where many take-offs are needed, might prove too costly. But it is attractive, none the less.

As regards controls, I have in mind, of course, "direct control" of the rotor-head as in the C.30 and C.40 (tilting head) but it might well be, with modern know-how, that a simpler, lighter and "smoother" (i.e. less vibration to the hand) control would be possible.

This was, to my mind, the basic objection to the C.30 . . . it had a "hard mouth" (speaking in "horsey" terms). The C.40 almost quite got over all this so it could be done even in 1939. The fact that the rotor is not being driven must surely help.

I am quite, quite sure, there is a future for such a craft. It's silly to jettison simplicity when once you've had it and the complexity of the helicopter is due to its ability to fly sideways, backwards and to hover . . . none of which I want to do in my simplified design.

Hintlesham, Ipswich. H. PARHAM.

Groundabout

Ye Who Are About To Fade. . . . The current issue of the *Hawker Siddeley Review* provides grim evidence of The Trend. For the first time in its ten years, the journal carries neither pictures nor articles about aircraft. Just a couple of air news paragraphs at the back. At the recent Avro 504 Club dinner, "Dobbie" forecast that without aviation he would "just fade away." A likelier thing would be that without Sir Roy, aviation would fade away.

*

Croc. Spec. The "DC-3 replacement" should be amphibious and armour-plated, judging from conditions facing some DC-3s. For instance, Hunting-Clan African Airways' smart jobs couldn't use Kariba airstrip because of floods and, the authority's report might have added, "because of crocodiles." When the airfield controller sloshed out to check the depth of water on the runway, he had a feeling he was being watched—looking round, he found a croc. making a nice approach on instruments through the Zambesi's muddy overflow. The controller, who surely deserves some kind of recognition from the Guild of Air Traffic Control Officers, promptly closed the field and ordered an immediate diversion.

The DC-3 WREPLACEMENT

*

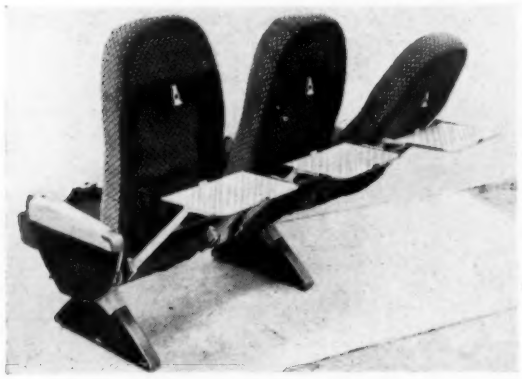
Down Wash. Ever hear of a helicopter having to drop anchor in a hangar? It happened at Sydney Airport when a rainflood had the T.A.A. hangar awash. A Bell on floats took off on the tide and had to be hastily moored.

*

Hip-Hip-Hooray! The Thruxton Jackaroo designers, faced with packing four people into the smallest space, produced after a lot of research a lay-out which passengers on the new Economy Class airline services would find a blessing, I'm sure. The seats are not only slightly staggered, they are also set at differing levels, thus avoiding the hip-to-hip crowding which nobody likes.

by Lorenzo

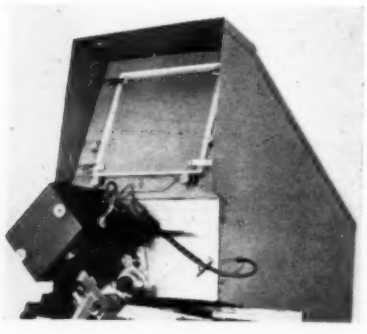
NOTES AND EVENTS



This new Microcell seat is in production for B.O.A.C. Britannias and Comets, and has been designed for tourist or economy class services. The seat back can be restricted in travel to suit the pitch, and the legs are easily adjustable for different track widths. The three-place unit weighs 75 lb., less lifebelts.

LIFE SAVER.—An air-rescue saw has been produced by Black and Decker, Ltd., in collaboration with the M.T.C.A. for effecting quick entry into the fuselage of a crashed aircraft. Weighing only 19 lb., the saw has a 2-h.p. 110-V. motor to drive the 12-in.-diameter blade which, it is claimed, can rip out a 3-ft.-square section of light alloy in 15 sec. A rescue attempt in the same circumstances with hand tools is calculated to take 2½ min.

CONTOUR-COMPARATOR. — An instrument which projects a 20× magnified image of the wing leading-edge contours of high-speed wind-tunnel models has been produced by the West London Optical and Tool Co., Ltd., of Witney, Oxfordshire. Developed for the Aircraft Research Association, Bedford, this instrument can be used to check the wing leading-edge radius and profile on aircraft and missile models whose sweepback is between 15° and 55°. The contour can be checked at any point along the span of the wing. Cost of the instrument (seen below) complete with 20× lens is £250; delivery is approximately four weeks.



FOR FIRE FIGHTING.—A new fireproof flexible metallic hose, designed to ensure absolute reliability of aircraft fire-extinguisher systems, and conforming to both A.R.B. and C.A.A. requirements, has been developed by Power Auxiliaries, Ltd., of Swindon. During tests the hose was subjected to a temperature of 2,200° F. for 15 min. and then a fire extinguisher was discharged into it. Despite the thermal shock of the sudden flow of cooling fluid the hose remained intact.

ALUMINIUM ADDRESS.—Devonshire House, Great Charles Street, Birmingham, 3, is the new premises of the Birmingham area sales office of the Northern Aluminium Co., Ltd., where Mr. D. W. Taylor will continue as manager. The telephone number is now Central 7393.

INTERIOR DECORATION.—South African Airways have ordered more than 3,000 yd. of Replin, a machine-woven tapestry made by the British Replin Mill, Ayr, Scotland. Incorporating the Protea flower, the Union's national emblem, the fabric will be used in all S.A.A. aircraft.

Aviation Calendar

April 15.—R.Ae.S. Section Lecture, "The Problems of Vertical Take-off," by Dr. C. T. Hewson, in the library, 4 Hamilton Place, **London,** W.1, at 19.00 hrs.

April 15.—Brit. Inst. of Radio Engineers lecture, "Factors in the Design of Airborne Doppler Navigation Equipment," by E. G. Walker, at the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, **London,** W.C.1, at 18.30 hrs.

April 16.—R.Ae.S. Preston Branch A.G.M. and film show, at the R.A.F. Association, **Preston,** at 19.30 hrs.

April 16.—R.Ae.S. London Airport Branch lecture, "Titanium," by H. W. Shaw, Ph.D., B.Sc., A.M.I.Mech.E., A.M.I.E.E. (I.C.I.), at **London Airport,** at 18.00 hrs.

April 16. — Kronfeld Club lecture, "Second World War Flying and Escape from Stalag III," by O. L. S. Philpot, at 74 Eccleston Sq., **London,** S.W.1, at 20.00 hrs.

April 18.—British Women Pilots' Association, talk by C. A. Nepean Bishop, at the Kronfeld Club, 74 Eccleston Sq., **London,** S.W.1, at 19.30 hrs.

April 21.—Women's Engineering Society London Branch lecture, "Philosophy of Guided Missile Design," by Wg. Cdr. P. M. Chettle, B.Sc.(Eng.), at the Central Electricity Authority headquarters, Winsley Street, **London,** W.1, at 18.45 hrs.

April 23.—R.Ae.S. Leicester Branch A.G.M. and film show in the lecture theatre, **Loughborough College,** at 18.45 hrs.

April 25.—Inst. of Navigation meeting, "The Use of Simulators for Training Navigators to Use Radar Equipment"—a description with contributions from the R.N., the R.A.F. and M.T.C.A., at the R.G.S., 1 Kensington Gore, **London,** S.W.7, at 17.15 hrs.

May 4.—Tiger Club Aerobatic Competition at **Sywell Aerodrome,** Northampton.

CARGO LIFT.—Designed to speed up the loading and unloading of aircraft, a new cargo lift truck larger than the Karrier Gamecock has been produced by the Rootes Group. Based on a Commer forward-control wheelbase, the body of the truck can be raised platform-style 13 ft.—high enough to meet the loading bay of any type of aircraft. It can lift loads up to five tons and is powered by either a Diesel or a petrol engine.

Company Notices

NEW COMPANIES

A. J. Walter, Ltd. (600,714).—Private co. Reg. March 18. Cap. £5,000 in £1 shs. Objects: To carry on the business of manufacturers and repairers of and dealers in aircraft and motor vehicles or boats, etc. Directors are: Anthony J. Walter, The Old Hatchgate, Massetts Road, Horley, Surrey; Norman H. Davis and Michael I. Gee, both of 40 Portland Place, London, W.1. Sec.: Della Walter. Reg. Off.: Gatwick Airport, Horley, Surrey.

Communications (Air), Ltd. (601,072).—Private co. Reg. March 24. Cap. £100 in £1 shs. Objects: To carry on the business of manufacturers or dealers in, hirers, installers, suppliers, repairers, maintainers and servicers of wireless, radio, television and radar sets, and wireless and radio equipment, installed or used in aircraft or vehicles of all kinds, etc. Directors: Henry F. J. Wigram, "Oakdene," London Rd., Sunningdale, Berks; Francis G. Noble, "Rosebank," Windlesham, Surrey, directors of Air Transport (Charter) (C.I.), Ltd., etc. Sec.: F. G. Noble. Solrs.: Hill, Dickinson and Co., 3-6 Bury Court, St. Mary Axe, London, E.C.3. Reg. off.: 7 Willow Rd., Poyle Trading Estate, Colnbrook, Slough, Bucks.

James Walker Aircraft Development, Ltd. (600,872).— Private co. Reg. March 19. Cap. £100 in £1 shs. Objects: To carry on the business of manufacturers of and dealers in tools, patterns, etc. Directors: Marshall Walker, 72 Friern Barnet Lane, London, N.11; Ian F. Walker, 36 Friary Rd., London, N.12; and Terris G. Bowler, address not stated.

INCREASE OF CAPITAL

Surrey Aircraft, Ltd. (358,093), aeronautical and general engineers, etc. 44 Bow Lane, London, E.C.4—increased by £5,000 in £1 ordinary shs. beyond reg. cap. of £5,000.

New Patent

APPLICATION ACCEPTED

795,324.—Technique and Commerce, Bourcart, E. A., and Berger, M.—"Helicopters," —March 19, 1956. (March 17, 1955.)

Application open to public inspection on May 21, 1958; opposition period expires on August 21, 1958.

Personal Notices

BIRTHS

Carder.—On March 23, to Pamela, wife of Flt. Lt. A. S. Carder, R.A.F. Syerston—a daughter.

Collyer.—On March 23, to Ruth, wife of Flt. Lt. J. T. Collyer—a daughter.

Cubey.—On March 26, at the David Bruce Military Hospital, Malta, to Pamela (*née* Hildreth), wife of Sqn. Ldr. J. B. Cubey—a son.

Gill.—On March 29, at Fulford Hospital, York, to Judy (*née* Appleyard), wife of Gp. Capt. L. W. G. Gill—a son.

Hammersley.—On March 26, at the R.A.F. Hospital, Halton, to Audrey (*née* Dixon), wife of Sqn. Ldr. H. A. N. Hammersley—a daughter.

Hurry.—On March 28, at the Hainault Maternity Hospital, Erith, Kent, to Edwina Marie (*née* Page), wife of Wg. Cdr. J. Hurry, R.A.F.—a son.

MARRIAGE

Hunter—Skov.—On March 29, in Copenhagen, Sqn. Ldr. B. V. Hunter, of Leicester, to Miss E. J. Skov, of Copenhagen.

DEATH

de St. Leger.—On March 28, at the R.A.F. Hospital, Halton, Gp. Capt. R. J. M. de St. Leger, R.A.F. (Retd.), of Robbin Hill, Duffield, Derbyshire.